Specific Contract No. 8

FRAMEWORK CONTRACT

EASME/EMFF/2016/008

Scientific Approaches for the Assessment and Management of Deep-Sea Fisheries and Ecosystems in RFMOs and RFBs

FINAL REPORT

November – 2018

EUROPEAN COMMISSION

Executive Agency for Small and Medium-sized Enterprises (EASME)

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PDF:	ISBN: 978-92-9202-442-0	doi: 10.2826/35050	EA-02-19-180-EN-N
HTML:	ISBN: 978-92-9202-441-3	doi: 10.2826/08577	EA-02-19-180-EN-Q

Executive Agency for Small and Medium-sized Enterprises (EASME)

FRAMEWORK CONTRACT – EASME/EMFF/2016/008 on " Scientific Approaches for the Assessment and Management of Deep Sea Fisheries and Ecosystems in RFMOs and RFBs "

CONTENTS

EXECUTIVE SUMMARY

ENGLISH

Globally, there are ten regional organisations responsible for the management of fisheries for non-migratory species in areas beyond national jurisdiction. Regional Fisheries Management Organisations (RFMOs) have a legal mandate to ensure the sustainable use of marine living resources in these areas, although the two organisations in the eastern and western equatorial Atlantic (CECAF and WECAFC) are limited to an advisory role and formally designated Regional Fishery Bodies (RFBs) only. Unlike RFMOs, RFBs do not have a Convention document, and cannot implement binding measures to which member states must adhere (e.g. areas closed to fishing). In this review, we discuss the varying strategies adopted by these organisations to manage deep-water fisheries (400m and deeper), with a particular focus upon measures designed to limit deleterious impacts upon sensitive benthic ecosystems. Each organisation is scored against 102 criteria which relate to their status, capacity, and actions to manage bottom fisheries. The North Atlantic RFMOs (NEAFC and NAFO), and CCAMLR were the highest scoring organisations, with CECAF, WECAFC and the South Indian Ocean Fisheries Agreement (SIOFA) consistently amongst the lowest scoring organisations. To explore the extent to which each organisation is meeting its objectives, each of these criteria are grouped according to whether they best represent an organisation's ***capacity*** (what it can do); ***need*** (what it should do); and ***action*** (what it has or is doing), as a means to assess how each organisation is performing. The ***action*** and ***need*** scores for most organisations are broadly proportional (i.e. the more an organisation does to limit adverse impacts, the less needs to be done), but comparisons between capacity and action highlight where organisational improvements should be made. Several organisations still have substantial ***capacity*** gaps (particularly CECAF and WECAFC) and should be targeted for additional technical and financial support. Others, such as the Mediterranean Fisheries Council (GFCM), progress appears not to be commensurate with their collective capacity, perhaps owing to more a more complex geopolitical setting. This review provides detailed background information for each organisation and makes a number of recommendations for future research and policy direction.

FRANÇAIS

A l'échelle globale, il y a dix organisations régionales responsables de la gestion de la pêche d'espèces non migratrices dans les zones se trouvant hors juridiction nationale. Les Organisations Régionales de Gestion de la Pêche (ORGP, ou RFMO) ont le mandat légal d'assurer l'usage durable des ressources halieutiques dans ces zones, à l'exception des deux organisations pour l'Atlantique Centre-Est (COPACE, ou CECAF) et Centre-Ouest (COPACO, ou WECAFC) ayant un rôle purement consultatif en tant que Regional Fishery Bodies (RFB). Ces RFB n'ont pas de convention ni de pouvoir juridiquement contraignant pour mettre en place des mesures auxquelles chaque membre doive adhérer (par exemple fermer des zones à la pêche), contrairement aux ORGP. Dans cette étude, nous discutons les différentes stratégies adoptées par ces organisations pour gérer la pêche en eaux profondes (>400m), en se concentrant plus particulièrement sur les mesures conçues pour limiter les impacts délétères sur les écosystèmes benthiques sensibles. Chaque organisation est notée en fonction de 102 critères liés à leurs statut, capacité et actions en matière de gestion des types de pêche dont les engins entrent en contact avec les fonds marins. Les organisations ayant obtenues les meilleurs scores sont les ORGP de l'Atlantique Nord (CPANE et OPANO, ou NEAFC et NAFO), et CCAMLR. A l'inverse, la COPACE, la COPACO et l'Accord relatif aux pêches dans le sud de l'océan Indien (SIOFA) sont systématiquement les organisations les moins performantes. Pour déterminer et évaluer dans quelle mesure chaque organisation atteint ses objectifs, les critères sont regroupés suivant s'ils représentent ou non la

capacité d'une organisation (ce qu'elle peut faire), les besoins (ce qu'il y a à faire), et l'action (ce qu'elle fait ou a fait). De façon générale, les scores sous les catégories action and besoins sont proportionnels (c'est-à-dire que plus une organisation agit pour limiter les impacts négatifs, moins il y a de besoins), mais la comparaison entre capacité et action met la lumière sur les domaines dans lesquels des améliorations organisationnelles devraient être apportées. Plusieurs organisations ont encore d'importantes limitations en termes de capacité (en particulier le COPACE et la COPACO) et bénéficieraient d'un soutien technique et financier supplémentaire. Pour d'autres, comme la Commission générale des pêches pour la Méditerranée (CGPM, ou GFCM), les progrès ne semblent pas correspondre à leur capacité collective, sans doute en raison d'un cadre géopolitique plus complexe. Cette étude contient des informations détaillées sur le contexte de chaque organisation et formule un certain nombre de recommandations de recherche et politiques pour le futur.

ESPAÑOL

A nivel global hay diez organizaciones regionales responsables de la gestión de las pesquerías de especies no migratorias en aguas internacionales. Estas Organizaciones Regionales de la Ordenación Pesquera (OROP) tienen la obligación legal de asegurar el uso sostenible de los recursos vivos marinos en sus respectivas áreas de influencia, aunque las dos organizaciones en el Atlántico ecuatorial oriental y occidental (CECAF y WECAF, respectivamente), están limitadas a una función meramente asesora y tienen la designación formal de Órganos Regionales de Pesca (ORP). Al contrario que las OROP, las ORP carecen de un Tratado y no pueden implementar medidas vinculantes de obligatorio cumplimiento por los Países Miembros, p. e., cerrar áreas a la pesca. En esta revisión se exponen las diferentes estrategias adoptadas por estas organizaciones para gestionar las pesquerías de aguas profundas (aquellas que tienen lugar a más de 400 m de profundidad), con especial atención en las medidas diseñadas para limitar los efectos perjudiciales en ecosistemas bentónicos vulnerables. Cada organización se puntúa en base a 102 criterios relacionados con su condición, capacidad y acciones para gestionar las pesquerías demersales en las que el aparejo entra en contacto con el fondo marino. Las OROP del Atlántico Norte (NEAFC y NAFO) y CCAMLR fueron las organizaciones que alcanzaron las puntuaciones más elevadas, mientras que CECAF, WECAFC y SIOFA se situaron entre las ORP y OROP con menor puntuación. Los criterios empleados se agruparon en función de si representan las ***capacidades*** (lo que una organización puede hacer), las ***necesidades*** (lo que una organización necesita) o las ***acciones*** (lo que una organización ha hecho o está haciendo), con el fin de analizar la eficiencia de las diferentes OROP y ORP en alcanzar sus objetivos y poder evaluar su gestión. Las puntuaciones correspondientes a las ***acciones*** y las ***necesidades*** son bastante proporcionales (es decir, cuanto más está haciendo una organización para limitar impactos negativos, menos necesitará hacer en el futuro), pero las comparaciones entre capacidad y acción ponen de relieve dónde son necesarias mejoras. Algunas organizaciones todavía tienen vacíos en sus **capacidades** (sobre todo CECAF y WECAF) y deberían recibir apoyo adicional técnico y económico con carácter preferencial. En otras, como el GFCM, los avances no parecen ser proporcionales a su capacidad colectiva, quizás debido a contextos geopolíticos más complejos. Esta revisión ofrece información básica detallada sobre cada organización y presenta varias recomendaciones para posibles líneas de investigación y gestión futuras.

1. INTRODUCTION

1.1 Background and Justification

The deep-sea includes over 90% of the world's oceans and is thought to be one of the most diverse ecosystems in the world (Jobstvogt *et al.*, 2014). Whilst it has generally been asserted that the deep-sea occurs at depths greater than 200 m, this definition is predominantly geologically-based, as it typically represents the depth at which most continental shelves become continental slope (EU FP6 DeepFishMan). However, from an ecological stand point, the transition between photic and aphotic conditions is more meaningful, and indeed studies have shown that the transition from shelf to predominantly deep sea populations of fish occurs at greater depths, typically between 300 and 500 metres (Mangi *et al.* 2016). A depth of 400 metres was therefore used as the shallow water limit defining deep sea fishing which targets predominantly deep-water species of fish, extending to a maximum depth of 2000 metres, which is the physical limit of most modern-day deep-sea fishing operations. The defining characteristic of the deep-sea in comparison to other environmental domains is that it supports unique ecosystems that remain poorly understood (Jobstvogt *et al.*, 2014; Van Dover *et al.*, 2012). Although deep-sea ecosystems are poorly understood, there is near-consensus that deep-sea fisheries are overexploited (Moore and Squires, 2016) and therefore significant global efforts are currently underway to improve conservation and sustainable use of the deep-sea resources and ecosystems on the high seas.

Deep-sea fisheries take place at great depths (between 400-2000 meters) in both exclusive economic zones (EEZs) and in Areas Beyond National Jurisdiction (ABNJ) on continental slopes, oceanic seamounts, ridges, canyons and spurs. The actual surface area of the global ocean sea floor between the 400 and 800 metre isobaths is perhaps unsurprisingly small due to the relatively steep transition between continental slope and abyssal plain, approximately 2% of the global ocean, compared with 9% in waters less than 400 m deep (Fig 1.1). Deep-sea fish species and their stocks are commonly considered particularly vulnerable to unregulated fishing activity since some species tend to be relatively slow-growing and mature much later than their shallow-water relatives, making them much more vulnerable to over-exploitation (Winemiller and Rose, 1992; Koslow *et al.*, 2001; Morato *et al.*, 2006). For example, Cailliet *et al.* (2001) estimated that rougheye (*Sebastes aleutianus*) can reach an age of up to 200 years.

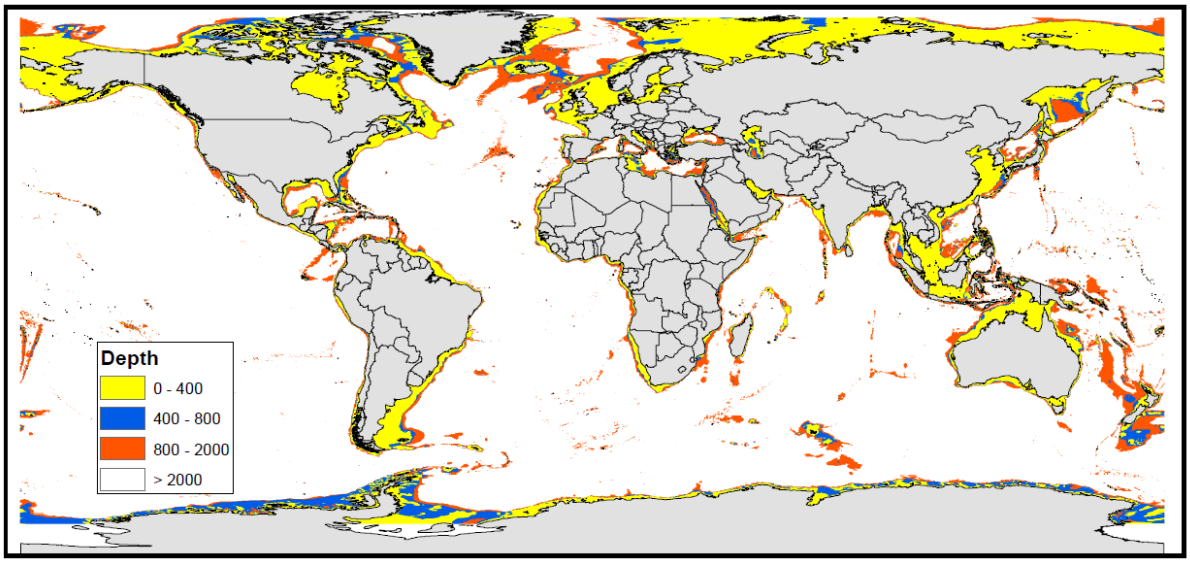

Figure. 1.1 – Area of seafloor in 0 – 400 (yellow) where all shelf-based fisheries can be found; 400 – 800 m (blue) where most of the traditional deep-sea fisheries operate; and 800 – 2000 m depth bands (orange), generally restricted to more recent deep-sea fisheries.

Deep-sea fisheries target benthic or benthopelagic species using different types of fishing gear, such as bottom and mid-water trawls, pots and longlines. These fisheries commonly require significant investment. The types of fishing gear, vessels and number of people employed in these fisheries vary greatly, though the majority are commercial and technologically advanced operations, using a variety of gear types. Commercial fishing in the deep-sea is also moving into deep water as the mean depth of fishing activity has increased by 350 m since 1950 (Mengerink *et al.*, 2014).

The Food and Agriculture Organisation (FAO) published guidelines, "The International Guidelines for the Management of Deep-Sea Fisheries in the High Seas" (FAO DSF[1]), provide general guidelines for deep-sea fisheries, which in turn are used by States and Regional Fisheries Management Organizations (RFMOs) in formulating and implementing appropriate measures for the management of their deep-sea fisheries in the high seas. However, these guidelines have been fully adopted only by a few coastal and flag states (Rogers and Gianni, 2010).

Some of the fishing gears used in deep-sea fisheries can, in the normal course of operation, come into contact with the sea floor. Significant adverse impacts (SAIs) on Vulnerable Marine Ecosystems (VMEs) can occur during fishing operations, particularly with the use of bottom-contact gears like otter trawls (FAO, 2009). The scale and significance of the impact determines whether the impact can be considered a Significant Adverse Impact (SAI). This occurs when *inter alia* the ecosystem function is impaired, and the long-term natural productivity of the seabed environment is degraded beyond a temporary basis.

International concerns over the impacts of deep-sea fishing has been the subject of extensive debate in the United Nations General Assembly (UNGA) leading to the adoption of a series of UNGA resolutions to protect deep-sea VME (UNGA, 2008). Once a VME has been designated and potential SAIs assessed, the FAO DSF Guidelines (FAO, 2009) recommend specific conservation and management enforcement measures be adopted.

Some studies carried out in different deep-sea habitats have shown that the benthic communities in these environments have low resilience to disturbance and low levels of secondary production, compared to shelf based equivalent habitat types, highlighting the importance of protecting seabed habitats as an integral part of deep-sea fisheries management (Mangi *et al.*, 2016). However, many areas of the deep sea, especially areas of deep sea at fishable depths, are poorly understood and typically warrant a more precautionary management approach commensurate with the potential risks of causing significant adverse impacts (SAI) on Vulnerable Marine Ecosystems (VMEs). Therefore, the protection of deep-sea ecosystems to support sustainable of deep-sea fisheries has been widely recommended.

Some RFMOs have been proactive in formulating rules related to deep-sea fisheries exploitation, but the scope and ambition of these measures are often not applied or implemented consistently across all RFMOs (e.g. the scope of implementing fisheries closures to protect VMEs varies greatly between RFMOs). While RFMOs are given a central place in the management of these fisheries, those responsible for deep-sea fishing vary widely in scope, authority, participation by fishing nations and especially the robustness of the scientific advice provided. As a consequence, the scientific and management approaches in RFMOs for assessing deep-sea fisheries and ecosystems are broad and variable, especially in relation to:

- **i.** establishing methods for assessing impacts (often referred to as assessing Significant Adverse Impacts, SAI);
- **ii.** defining areas where fishing is permitted (fishing footprint);
- **iii.** monitoring fishing activity;

[1] http://www.fao.org/docrep/011/i0816t/i0816t00.htm

iv. applying habitat suitability models to predict the distribution of VME indicator species;

v. quantifying the risk of VME impacts; and

vi. developing and applying VME encounter protocols for fisheries.

1.2 Project purpose, scope and aims

The aim of the project is to provide a comprehensive review and analysis of the scientific approaches adopted and being developed by each of the RFMOs and RFBs listed below, which manage bottom fishing activities. This review complements earlier work by Lodge et al., (2007) and Cullis-Suzuki et al., (2010), since these reviews focussed upon governance and fishery stock management, rather than the mitigation or avoidance of impacts ion VME n the deep-sea. The purpose of this desk-study is to provide the European Commission with a robust evidence base upon which to compare and contrast the performance of different Regional Fishery Management Organisations, with respect to deep-sea fishing, including the management of fish stocks, but with particular focus upon the avoidance and mitigation measures designed to conserve and protect Vulnerable Marine Ecosystems, species, habitats and biodiversity in the deep sea.

This report is essentially divided into two parts, namely; **Part i**. undertakes a comparative analysis of the RFMOs/RFBs to assess their relative performance, whilst **Part ii. is presented as** a series of annexes that provide a description of the RFMOs/RFBs in question, addressing each of the sub-headings defined during the scoping phase of this study (see below). The review considered only readily available (public) information (see Section 1.3) for each of the following RFMOs/RFBs which have significant bottom fishing activities (Fig. 2.1):

- CCAMLR The Convention for the Conservation of Antarctic Marine Living Resources
- CECAF The Fisheries Committee for the Eastern Central Atlantic
- GFCM The General Fisheries Council for the Mediterranean
- NAFO The Northwest Atlantic Fisheries Organisation
- NEAFC The Northeast Atlantic Fisheries Commission
- NPFC The North Pacific Fisheries Commission
- SEAFO The Southeast Atlantic Fisheries Organisation
- SIOFA The South Indian Ocean Fisheries Agreement
- SPRFMO The South Pacific Regional Fisheries Management Organisation
- WECAFC The Western Central Atlantic Fishery Commission

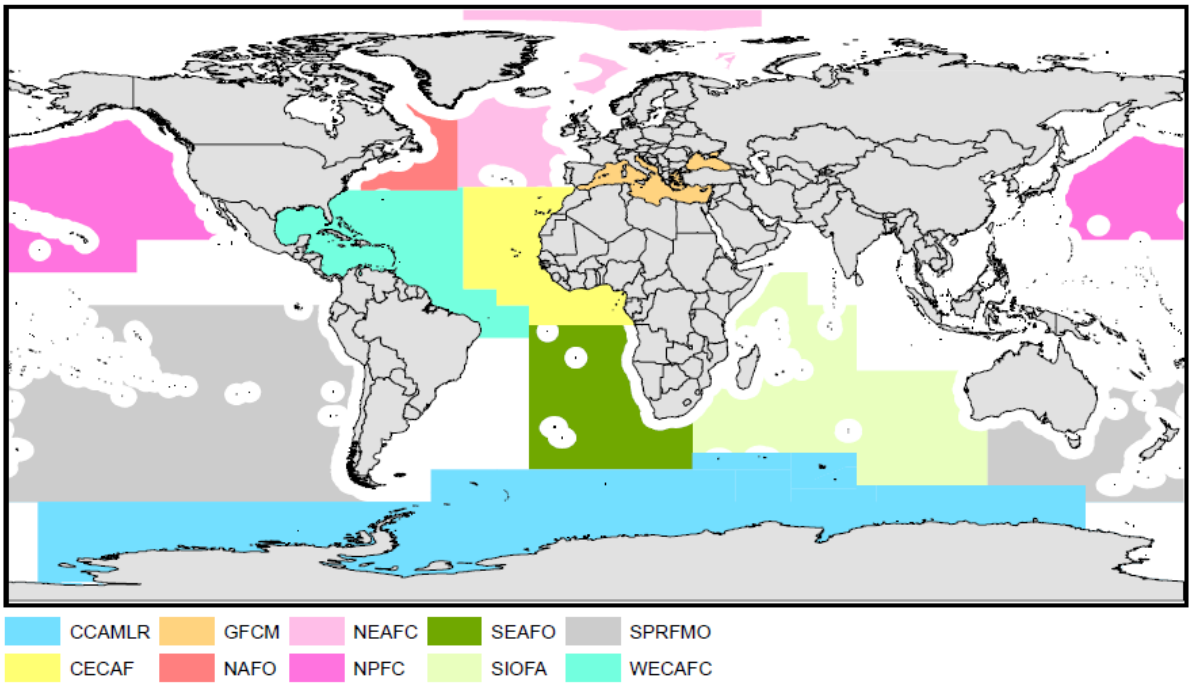

Figure 2.1 – Area of competence for each RFMO/RFB considered in the present review (the areas represent areas of jurisdiction which in some cases include national Contracting Party waters as is the case for GFCM). N.B. The SEAFO convention area also overlaps with the CECAF area in the region to the north of Ascension Island (central Atlantic). WGS84.

1.3 RFMO/RFB data and information reviews

The information and data sources reviewed in this study are diverse, e.g. published RFMO/RFB working group and meeting reports, FAO workshop reports, published material and data on RFMO/RFB websites and personal contact with selected RFMO/RFB secretariat staff to obtain less 'visible' data and information sources relevant to the study. At the project "kick-off" meeting the consortium considered several specific questions to be addressed in relation to each of the project sub-tasks as defined in the project scope (see below). The questions relate to the identification and documentation of the different types of data and information believed to be readily available (in most cases) from each of the RFMOs/RFBs. The criteria presented here were selected to cover the full range of activities and characteristics of each organisation that are relevant to its management of deep-water fishing. However, some of the criteria are excluded from the subsequent meta-data analysis, either because too few data were available across all organisations reviewed or certainty in the data either estimated or obtained was deemed to be too unreliable.

Sub-task 1. Data Availability and Governance Frameworks

a. What is the remit of the RFMO/RFB (e.g. CCAMLR is not an RFMO but an organisation responsible for all marine life in the Southern Ocean, including fishery resources)?
b. What organisational governance and coordination frameworks are in place (e.g. is there a secretariat?; if so how many staff does it have?; are there any organised scientific expert groups, if so how often do they meet, Are there published fishery enforcement and conservation measures in place?)
c. How many and which contracting parties are signatories to the RFMO/RFB?
d. Are data on fishery catches and landings routinely collated, stored and assessed, if so by what methods?

e. Are VME survey data on species and habitat characteristics routinely collated, stored and assessed, if so by what methods?
f. Is VMS data routinely collated, stored and assessed, if so by what methods?
g. Are any reports (scientific, assessment, data, advice etc) routinely published, if so by whom, what and how often?
h. How accessible are the data and reports, e.g. can the data be accessed by the public, or by members only, can it be downloaded from website?
i. How aggregated are the data? e.g. actual positions, 1°x1° square, 5°x5° square etc.

Sub-task 2. Fisheries and stock assessment methods

i. How many fisheries are there in the RFMO/RFB and which are the dominant/common target species?
ii. How many stocks and how often are they assessed, and which are the species?
iii. What assessment methods are used? (e.g. fishery independent surveys and fully quantitative assessments, or trends-based assessments using minimal data etc.)
iv. Has a fishing footprint be defined and by what method?
v. What are the number and type (e.g. length/ Gross Registered Tonnes) of bottom fishing vessels and what type of gears do they use?
vi. What are the average annual landings by weight and by species?
vii. What is the average annual value of the total fishery and by species in the RFMO/RFB?
viii. Which are the main markets for the fish (e.g. to supply local consumption, or exported to other countries or vessels outside the RFMO/RFB)?

Sub-task 3. Description of sensitive species and habitats

a. Are species richness and diversity estimates available for at least some of the RFMO/RFB, if so, what are they?
b. Are there any defined VME indicator species lists, if so, what are they?
c. What definition of VME is used by the RFMO/RFB?
d. How many different types of VME have been recorded and what are the dominant species?
e. If known what are the predominant life history characteristics of the dominant fish and invertebrates associated with the VME?
f. What are the dominant habitat types in the RFMO/RFB (e.g. canyons, continental slope, sea mounts, spurs and ridges, gullies and passes)?
g. What are the depths at which these habitats typically occur?
h. Are there any other physical features that are especially important in determining the diversity, productivity and ecology of the features described, e.g. strong frontal current mixing or upwelling?

Sub-task 4. Assessment of bottom fishing impacts

a. Are fishery independent surveys routinely conducted to investigate bottom fishing impacts, if so what and how often?
b. Are scientific observer data collected and stored for fish catches?
c. Are *ad hoc* scientific surveys conducted to assess bottom fishing impacts?
d. Which are the sampling methods used and are the studies published?
e. Are there methods established for assessing Significant Adverse Impacts on VME, if so, what are they and how often are they conducted?

Sub-task 5. Mapping of sensitive species and habitats

a. Are scientific observer data collected, mapped and stored for VME indicator species?
b. Are routine fishery independent surveys conducted to sample VME indicator, if so, are the data recorded, mapped and stored?
c. What is the total extent (km^2), or approximate estimation, of the different VME types?
d. Have habitat suitability models (those which include environmental and biological data) been developed and applied in the RFMO/RFB, if so, what method was used, including types of environmental data integrated into the models?
e. Have species distribution models or methods (which do not use environmental data) been developed and applied in the RFMO, if so, what method was used, including types of data (e.g. kernel density estimates on biomass and abundance data)?

Sub-task 6. Impact mitigation and protection measures

a. What is the total area (km^2) of the RFMO and are there any defined sub-areas (e.g. fishing footprints, regulatory areas. If so, what is the extent of such areas (km^2)?
b. Are there any VME encounter rules which the fisheries use, if so, what are they and for what species?
c. Are there any VME fishery closures in place, if so, what do they consist of? What area do they cover (km^2) and how long have they been in place?
d. Are there any Exploratory Fishery Protocols adopted, if so, what do they consist of?
e. List any gear/depth restrictions adopted as impact mitigation/protection measures?

Sub-task 7. Methods for the long-term monitoring of VME

a. Are VMEs routinely monitored, if so by whom and how often (e.g. annually, or periodically as part of *ad hoc* R&D programmes)?
b. Which are the types of sampling methods used for monitoring?
c. Are there any plans for the long-term monitoring or assessment of VME being developed, if so, what are they?
d. Are there any know impediments holding back the long-term monitoring of VME, if so, what are they?

2. RFMO/RFB COMPARATIVE META-DATA ANALYSIS

2.1 Data availability and Governance

All bottom fishery (non-tuna) RFMOs and RFBs obtain and provide some form of data on catches for stock assessment purposes, by-catch of VME indicator species and VMS fishing vessel tracking data. However, there is considerable variability in the quantity and quality of data obtained between the RFMOs/RFBs, with some of the greatest gaps occurring in CECAF, SIOFA and WECAFC (see Table 3.1).

The provision of reliable catch data is a priority in all RFMOs/RFBs, and most rely on established protocols and formats to ensure that the information is adequately compiled and stored for its effective use. There are, however, large differences in the quantity and quality of the collected and available data, which seem to decrease in those RFMOs/RFBs with complex geopolitical situations and/ or without management capacity (see Table 3.1). There are also significant gaps in the publicly available landings data, especially in CECAF, WECAFC, SEAFO, NAFO, and SIOFA. Some data used in RFMO assessments remains restricted, and so not included here.

Bycatch data exist in all RFMOs, but the quality and quantity of available data is highly variable, predictably more so in WECAFC and CECAF, but even in some of the better resourced RFMOs like NEAFC and NAFO. Documenting VME fishery encounters is mandatory in all RFMOs, except for CECAF and WECAFC (which have no legal authority to enforce such provision). Nevertheless, VME data records depend largely on scientific observer programmes, Contracting Party (CP) *ad hoc* research surveys and/or fishery independent surveys. VME encounters by commercial fishing vessels exceeding a certain threshold must be reported and action taken by moving-on a given distance before recommencing fishing activities. However, such reports are very few across all RFMOs and therefore, they tend to rely on *ad hoc* research surveys to identify the presence and distribution of VMEs, the exception being NAFO, NEAFC, CCAMLR and some parts of the GFCM, which routinely document by-catch of VME indicator species from their annual fishery independent surveys. Scientific observer data are available from all RFMOs, but the extent, detail and quality of records is very variable between the RFMOs. For example, in CECAF, GFCM, NEAFC and WECAFC, the presence of scientific observers is regulated and depends on the support and legal requirements of CPs such as the EU (e.g. Spain and Portugal in particular). In SIOFA and SPRFMO, observer coverage levels depend also on the gear type used by the fishery, for example trawlers have 100 % observer coverage, but other types of gears (e.g. long-lining) may be subject to reduced levels (e.g. 25% of trips) or no mandated coverage.

Regular fishery independent surveys in the high seas (e.g. EU, conducted by Spain, in NAFO 3LMNO each year) are the exception. As such, the provision of scientific observer data acquires special relevance and importance. While illegal, unreported and unregulated (IUU) fishing activity is a global problem for sustainable fisheries, it appears to be more of a problem in those RFMOs/RFBs which lack the capacity to monitor adequately fishing vessel activities within their jurisdictions. This is especially the case where the RFMO/RFB may have large numbers of artisanal fisheries, as in certain areas of GFCM, WECAFC and CECAF, where fishing vessels tend to operate without VMS. VMS data are captured and stored in all the RFMOs/RFBs (except for CECAF, SIOFA and WECAFC), although VMS data compliance seems to be lower in CECAF and SIOFA. AIS data are either not utilised or their availability is limited. Most RFMOs also keep lists of vessels that have incurred IUU fishing activities, and there is a policy to share them with other RFMOs.

All RFMOs host a website where information on some of their activities are made publicly available, but again, the quality and quantity of data and information is extremely variable between the RFMOs. For example, NAFO has an especially informative and useful website with much of its reports made publicly available, but available official catch data are very poor. General information on the different regulated stocks is very dispersed and difficult to compile. NEAFC's website holds numerous reports, but they are not very informative, and official catch data are found in the ICES WG reports, and much

of the important information concerning stock assessments and VME protection measures are available only through ICES WG reports available via the ICES website. By contrast, whilst the CCAMLR website provides a lot of detail, it restricts public access to much of the highlighted data and activities. In all cases, searching for specific data and reports hosted by RFMO/RFB websites is complex, time consuming, and, without considerable expert knowledge, usually results in inaccurate data.

Table 2.1 – *Comparative quantitative data on DATA and GOVERNANCE for bottom fishery RFMOs/RFBs*

DATA & GOVERNANCE	Notes	CCAMLR	CECAF	GFCM	NAFO	NEAFC	NPFC	SEAFO	SIOFA	SPRFMO	WECAFC
What is the total extent of the regulatory area (000 km²)	-	35,716.1	15,259.0	2,531.6	2,707.9	5,300.0	27,690.0	15,626.7	27,000.0	59,000.0	20,507.5
How many permanent staff in the secretariat?	-	23	2	9	11	6	5	2	2	6	1
What year was the secretariat established?	-	1980	1967	1997	1979	1999	2015	2004	2016	2009	1973
How many expert working groups does the RFMO have?	-	4	5	8	11	5	8	1	1	3	11
Number of [recurrent] working group meetings per year?	a[2]	1	1.5	8	8	9	8	1	1	3	0.5
What is the approximate secretariat annual budget?	b[3]	4,000,000	369,400	2,160,719	1,232,037	1,700,000	1,092,243	313,036	236,000	677,258	183,000
How many contracting parties/ member states are there?	-	25	34	24	14	6	8	7	9	15	34
Are data routinely collected on target fish catches?	c[4]	1	0.25	0.75	1	1	1	1	1	1	0.5
Are data routinely collected on target fish landings?	c	1	0.25	1	1	1	1	0	0	1	0.5
Are data collected on non-target species, including VME indicator species?	c	0.75	0.25	0.5	0.75	0.25	1	0.5	0.5	1	0
Are data routinely recorded on habitat characteristics?	c	1	0	0	0	0	1	0.5	0	0.5	0
Are VMS data recorded and stored?	d[5]	1	0	1	1	1	1	1	0	1	0
Are all vessels logging and providing VMS data?	c	1	0	1	1	0.75	1	0.5	0	1	0
What is the typical VMS logging frequency?	e[6]	0.5	-	0.5	0.5	0.5	1	0.5	0.5	1	-
What are the reporting standards: target species catch?	f[7]	1	1	1	1	1	1	1	1	1	0
What are the reporting standards: bycatch species catch?	f	1	0.5	1	0.5	0.5	1	1	1	1	0
Assessment Reporting (all types, e.g. fish, fisheries, environment, VME)	g[8]	15	1.2	8	8	-	1	1	0	1	1.5
Does the RFMO have a website?	h[9]	1	1	1	1	1	1	1	1	1	1

[2] Expressed as decimal if <1 meeting per year.
[3] Reported mean of last 3 years in EUR. Exchange rates from organisation standard currency given in notes page.
[4] 1 = Full, 0.75 = Full partial, 0.5 = Partial, 0.25 = Partial none, 0 = None, NA = Unknown.
[5] 1 = Yes, 0 = No, NA = Unknown.
[6] 1 = <1hr, 0.5 = 1 - 2 hrs, 0 = >2hrs.
[7] 1 = Full reporting expected, 0.5 = reporting standards waived under certain conditions, 0 = no reporting requirements.
[8] Typical number of assessment (or WG) reports produced each year.
[9] 1 = Yes, 0 = No.

Are reports, data and other information available online?[10]	h	1	1	1	1	0	1	1	1	1	1
Are scientific observer data collected, recorded and stored for fish catches including bycatch species?	h	1	0	1	1	1	1	1	1	1	0
What is the observer coverage (%)?	i[11]	100	N/A	25	100	0	100	100	50	100	35
Proportion of total Regulatory Area fished (km^2)	-	0.005	0.017	0.188	0.022	0.021	0.000	0.000	0.001	0.001	0.003
Proportion of total RA closed to fishing (e.g. VMEs) (km^2)	-	4.74	0.00	51.72	10.88	7.06	0.00	3.24	0.00	0.00	0.00

[10] The assessment criteria does not comment on the usefulness of available reports, which varies widely.

[11] % of trips covered by observers

2.2 Fisheries and stock assessment

The review of fisheries and stock assessment approaches between the RFMOs/RFBs revealed not only a highly variable number of target and bycatch species and fleets, but also a very diverse number of fished stocks formally assessed. There is also inconsistent quality and quantity of fisheries dependent and independent data used for each stock assessment (Table 2.2). Data quality and availability largely determine the type of stock assessment approach employed, with most RFMOs/RFBs employing some level of data-limited stock assessment approaches. Accordingly, fully quantitative assessments are the exception rather than the norm, as they generally require a wide-range of quantitative biological and fisheries data, which in most cases is not available.

The most prevalent deep-sea fisheries in RFMOs/RFBs operate as mixed fisheries employing predominantly otter-trawls and static long-lines. These fisheries are typically defined by the most abundant species targeted in their catches. As observed elsewhere, mixed fisheries in the deep sea are especially difficult to manage due to different species having very different life histories and there is some evidence to suggest that these differences are greater in the deep sea than in shallower waters associated with the Continental shelf (Mangi *et al.*, 2016). Such evidence would tend to support the argument that it is more important to adopt a multi-species stock assessment approach in the deep-sea for sustaining fishery resources than it is in shallower waters within national jurisdictions. However, stock assessments throughout the RFMOs/RFBs continue to be monospecific, with the exception of NAFO which has pioneered the development of an ecosystem 'roadmap' that takes a multispecies approach. However, even in NAFO the ecosystem approach is not fully operational at the multispecies level.

The extent of the fishing footprint expressed as the fishable proportion of the total RFMO/RFB Regulatory or Convention area varies widely, from <1% in SPRFMO (designated as fishing footprint), compared to nearly 40% in NEAFC (being designated as fishing footprint). The associated fishing effort conducted within each RFMO/RFB varies greatly, with some cases not fully reported (e.g. CECAF, NEAFC, SIOFA, WECAFC). Open access to VMS data is extremely limited, therefore in the present study an estimate of comparative fishing effort between RFMOs/RFBs was achieved by using open access Global Fishing Watch (AIS) data, which allows a consistent estimate of hours fished per year in each region globally. The results of the present study reveal that NEAFC, CCAMLR, CECAF, GFCM and NAFO have the greatest absolute effort in ABNJ (18.4 – 449.8k hrs. yr^{-1}). NPFC, SEAFO, SPRFMO, SIOFA and WECAFC all have far lower levels of fishing effort (between 0.5 – 5.7k hrs. yr^{-1}). Maps showing the distribution of this fishing effort for the period 2012 – 2016 are given in Figures 2.2.1 to 2.2.5.

The range of gears used is widest in GFCM, including otter trawls, drifting and set longlines, dredges, gillnets, purse seine, dredges and pots, reflecting the diversity of Mediterranean fisheries and the fact that there are no international waters in the GFCM region, and where fisheries are regulated by EU and/or national legislation of CPs. CECAF also lists several different gear types for bottom fisheries, something to be expected given the large number of fisheries operating in this RFMO and the importance of artisanal fisheries.

Table 2.2 – *Comparative quantitative data on FISHERIES and STOCK ASSESSMENT approaches for bottom fishery RFMOs/RFBs*

FISHERIES & STOCK ASSESSMENTS	Notes	CCAMLR	CECAF	GFCM	NAFO	NEAFC	NPFC	SEAFO	SIOFA	SPRFMO	WECAFC
How many target fish species are caught?	-	2	41	7	11	9	11	5	1	12	30
In general, how many bycatch fish species are caught?	-	35	-	32	53	37	3	15	4	0	0
How many fisheries are there?	a[12]	12	77	20	4	6	3	2	5	6	-
How many stocks are formally assessed?	b[13]	15	96	7	19	51	8	5	0	1	0
What is the stock assessment interval?	c[14]	0.5	0.5	1	0.75	0.3	0.25	1	0	1	-
What is the stock assessment approach (category type)?	d[15]	1	0.5	1	0.7	0.7	0.5	0.5	0	1	0
Is stock biomass assessed?	e[16]	1	0.5	1	1	0.3	1	0	0	1	0
Has a fishing footprint been defined?	e	1	0	0	1	1	1	1	0	1	0
What is the extent of the fishing area or footprint (demersal gears)?	f[17]	1	-	20	20	37	1	1	2	<1	<1
What is the maximum depth of demersal deep-sea fishing (metres)?	-	2,000	900	800	1,200	1,500	1,500	2,000	1,500	2,000	900
What is the total fishing effort?	g[18]	3,546	-	50,480	4,270	-	591	69	-	-	-
What is the total fishing effort? GFW 2012-2016 data	h[19]	29,900	167,267	449,795	18,380	36,266	462	1,301	3,606	4,056	5,715
How many vessels fish (in total) in the RFMO in a given year?	-	36	-	8,341	47	1,472	1,088	3	57	956	-
What is the average size of the fishing vessels within each fishery? (as an estimate)	i[20]	1	-	-	1	-	1	1	1	1	-
What types of fishing gear are used?	j[21]	LLS	OTB, OTM, LLS, GNS, FIX	OTB, LLD, LLS, GTR, GNS, PS, DRB, FPO	LLS, OTB	OTM, OTB, LLS	OTT	OTM, OTB, LLS, FPO	OTB; LLS; GLL	OTB, OTM, LLS	-
What is the total deep-sea demersal catches/ landings?	K[22]	250	-	-	-	173	7	-	-	-	671

[12] Most recent three-year mean.
[13] Number of stocks for which the organisation gives scientific advice in some form.
[14] Grade from 0-1 where 1 = annual (or less than annual) and 0 = no assessment. Give mean score across stocks.
[15] 1 = Fully quantitative, 0.5 = Trends only, 0 = Not assessed.
[16] 1 = Yes, 0 = No, NA = Unknown.
[17] Percentage of total regulatory area designated as fishing footprint.
[18] Fishing hours per year in the Regulatory Area or Convention Area (if RA not applicable) over 3 years.
[19] Fishing hrs per year^{-1} (0.1 degree gridded - all demersal and mid-water gear types in waters >400m) in the RA (or CA if not RA) using Global Fishing Watch (AIS) data. Excludes target species regulated by tuna RFMOs.
[20] Length in metres (or, 1 = >20 m, 0.5 = 10 - 20 m, 0 = < 10 m).
[21] OTB = Otter trawl, OTT = Multi-rig otter trawl, OTM = Mid water trawl, LLD = Drifting long lines, LLS = Set long lines, CND = Driftnet. Other gears missing from catch records but usually a minor component of effort.
[22] Best available estimate of most recent three-year mean, 000s tonnes (catch or landings, whichever appropriate). NEAFC figure is for 2015 only

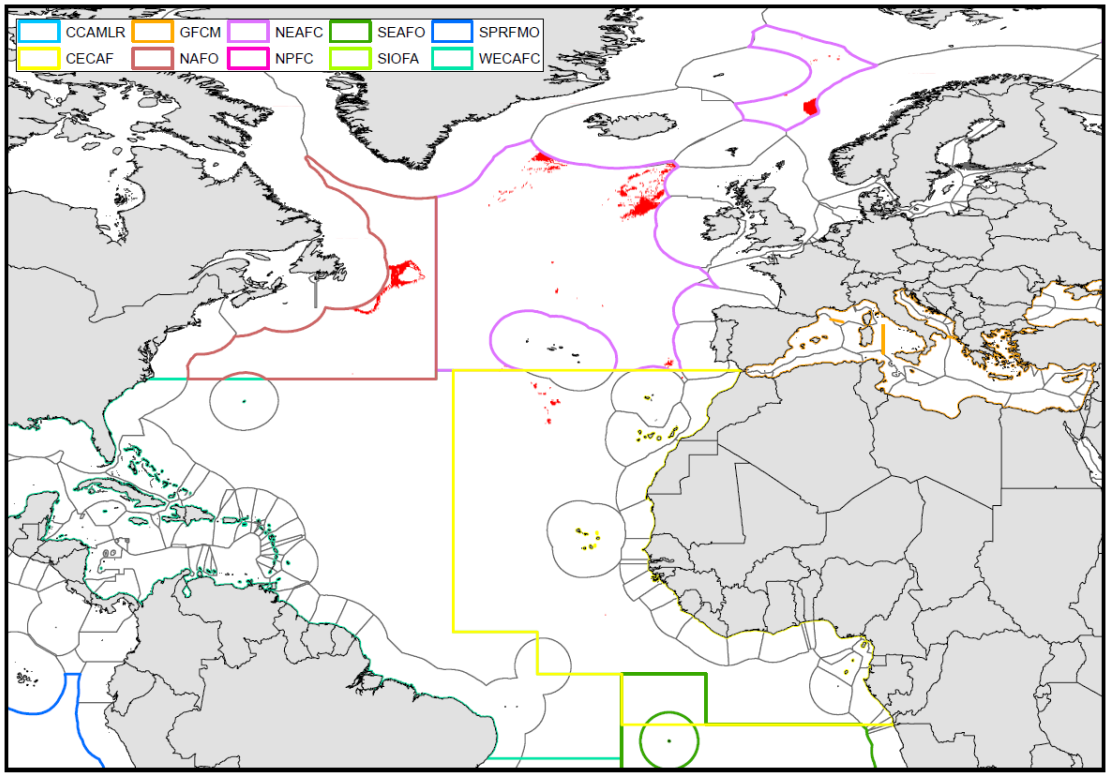

Figure 2.2.1 – Distribution of fishing effort in the North Atlantic (0.01 degree gridded demersal and mid-water gears in ABNJ, waters deeper than 400m). Source: Global Fishing Watch. Red areas indicate areas where fishing hours > 0 between 2012 – 2016).

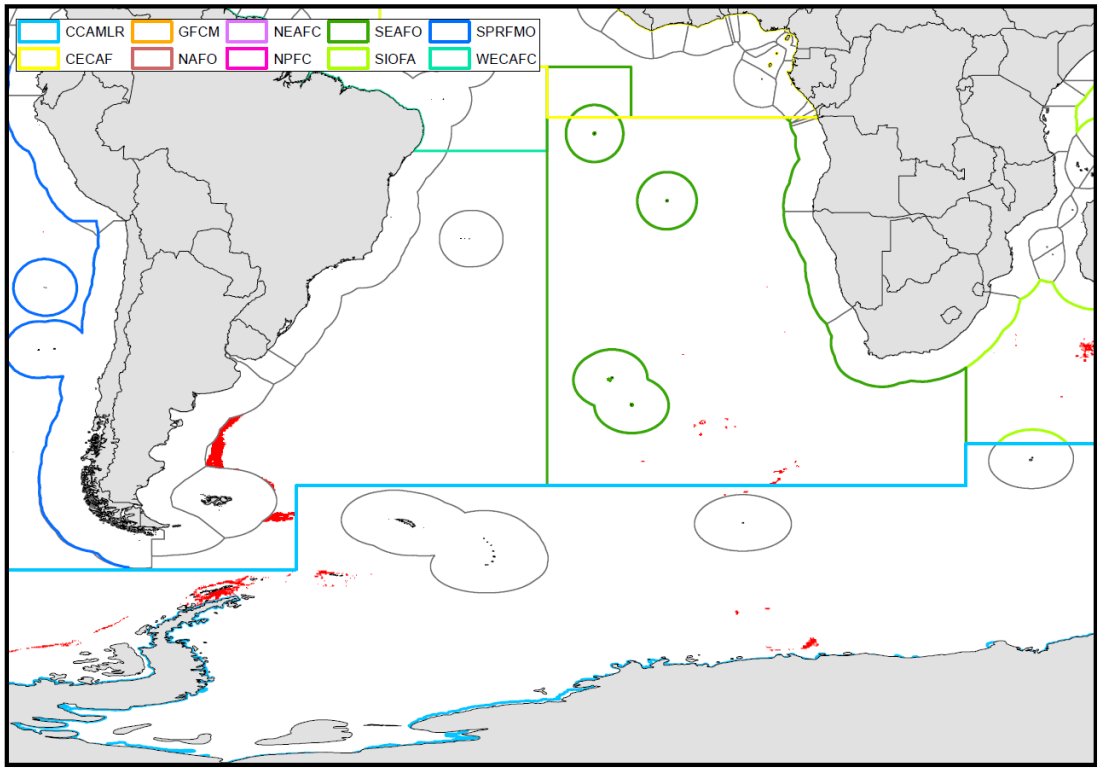

Figure 2.2.2 – Distribution of fishing effort in the South Atlantic (0.01 degree gridded demersal and mid-water gears in ABNJ, waters deeper than 400m). Source: Global Fishing Watch. Red areas indicate areas where fishing hours > 0 between 2012 – 2016).

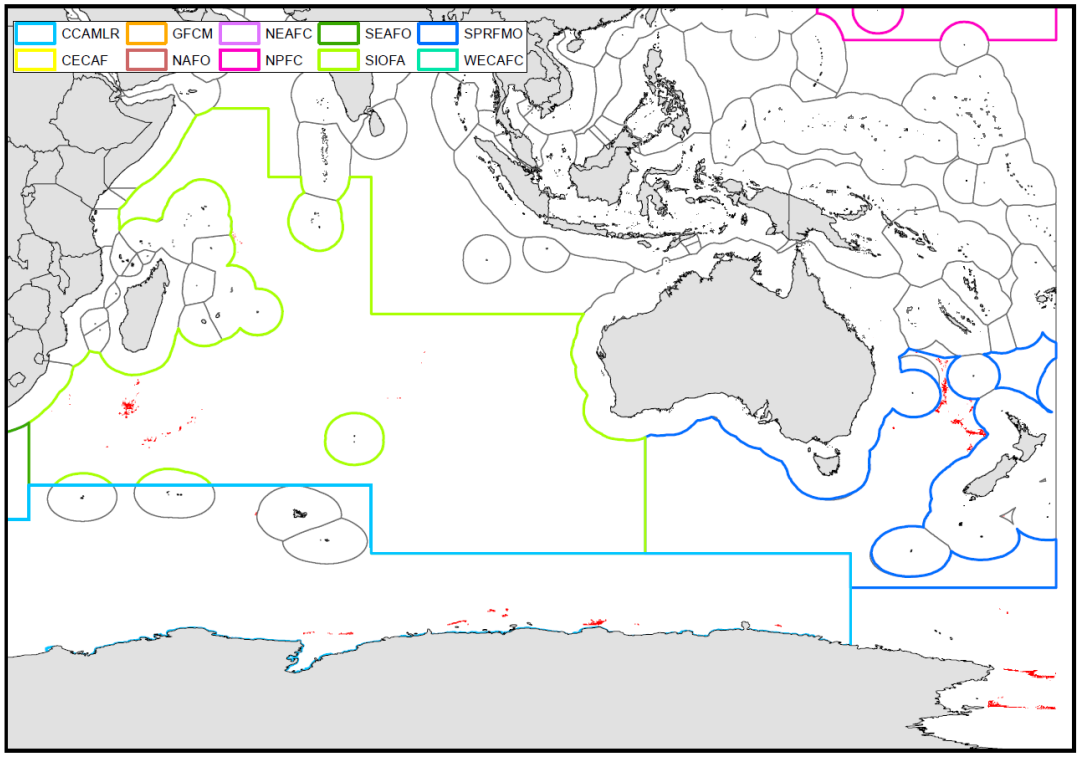

Figure 2.2.3 – Distribution of fishing effort in the South Indian and South-West Pacific (0.01 degree gridded demersal and mid-water gears in ABNJ, waters deeper than 400m). Source: Global Fishing Watch. Red areas indicate areas where fishing hours > 0 between 2012 – 2016).

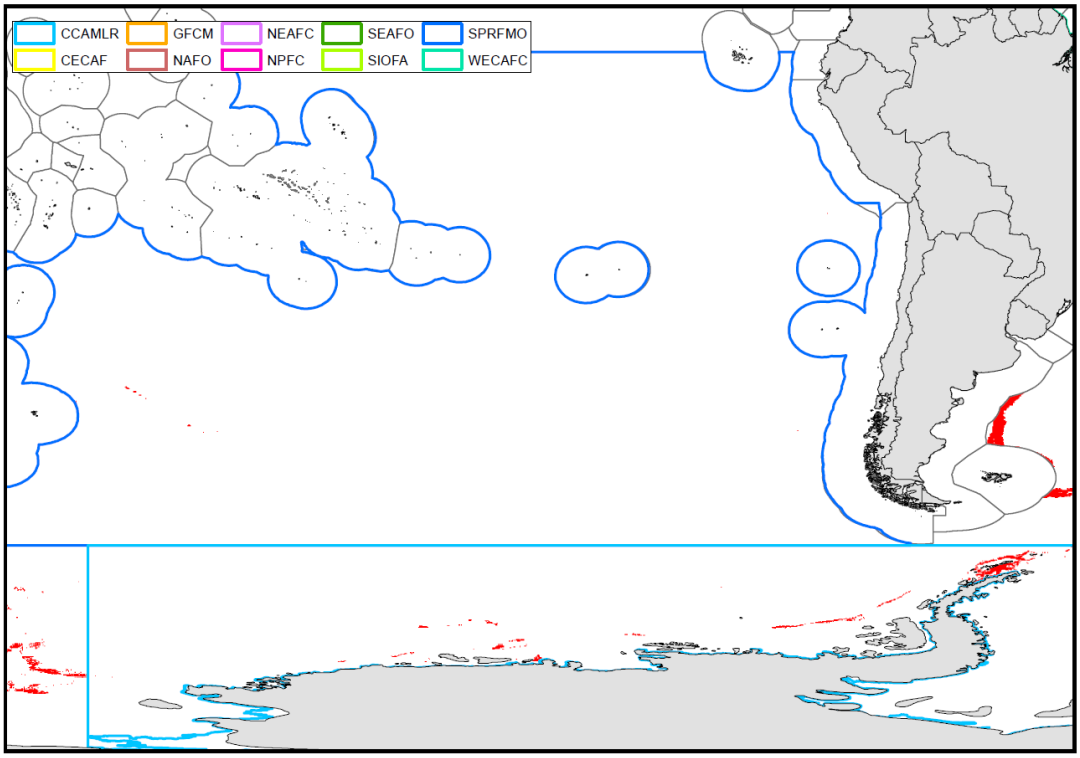

Figure 2.2.4 – Distribution of fishing effort in the South Pacific and Southern Ocean (0.01 degree gridded demersal and mid-water gears in ABNJ, waters deeper than 400m). Source: Global Fishing Watch. Red areas indicate areas where fishing hours > 0 between 2012 – 2016).

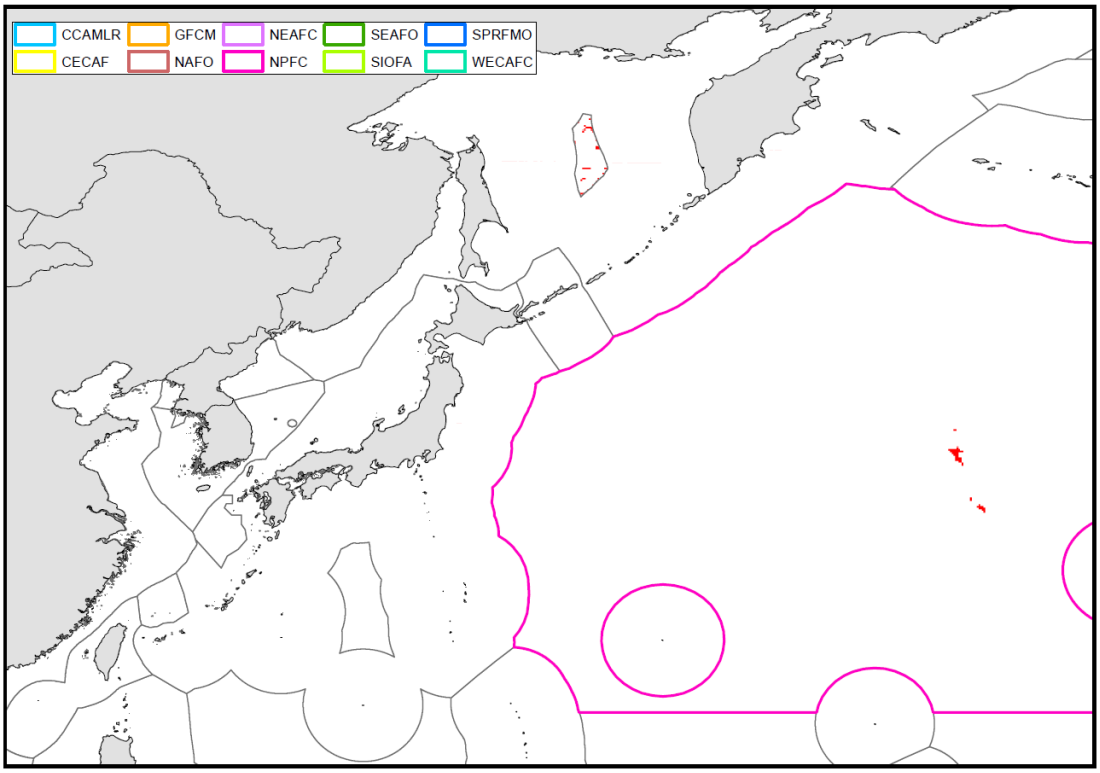

Figure 2.2.5 – Distribution of fishing effort in the Northwest Pacific (no fishing in NE Pacific) (0.01 degree gridded demersal and mid-water gears in ABNJ, waters deeper than 400m). Source: Global Fishing Watch. Red areas indicate areas where fishing hours > 0 between 2012 – 2016).

2.3 Species and habitats

Species and habitats are predominantly identified in RFMOs/RFBs as a result of a combination of the following types of survey, although not all types of surveys are conducted on a regular basis by any RFMO/RFB:

- fishery-dependent scientific observers documenting VME indicator species caught as incidental by-catch within commercial catches;
- routine fishery independent surveys (e.g., EU Spain/Portugal annual surveys in NAFO 3LMNO) where survey trawl catches are fully identified and enumerated;
- *ad-hoc* CP sponsored R&D surveys conducted to address wide-ranging ecosystem objectives e.g. EU VME habitat mapping surveys conducted by Spain in NEAFC and NAFO and fish stock surveys conducted in CECAF.

In order of priority, considering all RFMO/RFB assessment approaches, the following assessment approaches are the most commonly utilised (although there are some specific RFMO exceptions):

i. by recording (via scientific observes) fishery VME species encounters (this is the most relied upon approach in CCAMLR, NEAFC, NPFC, SEAFO, SIOFA, SPRFMO).
ii. through direct observations of VME indicator species on the seabed from fishery independent *ad hoc* R&D surveys using sonars, underwater cameras, trawls, grabs and dredges (NAFO, NEAFC, CCAMLR, SEAFO);
iii. by identifying certain sea bed features which are typically associated with VME habitat types (e.g. seamounts, canyons, ridges etc) from either published data sources or acquired by specially conducted multi-beam bathymetric surveys (NEAFC, NAFO).
iv. by conducting routine fishery-independent surveys (e.g. NAFO, NEAFC and to some extent GFCM, CCAMLR, NPFC and CECAF).

Conspicuous VME indicator species (e.g. megafaunal porifera and cnidaria species) are the most commonly documented phyla across all the RFMOs. Most VME indicator species are based on those defined by the FAO guidelines (FAO, 2009), but some RFMO CPs have conducted their own taxonomic research and have identified additional VME indicator species, notably CCAMLR (23 species) and NAFO (66 species), which meet their own regional needs (see Table 3.2). The NEAFC builds upon work conducted by NAFO. WECAFC, SPRFMO, SIOFA, NPFC and CECAF have done less work on species and habitats when compared to CCAMLR, GFCM, NAFO, NEAFC and SEAFO, especially in terms of VME species and habitat identification.

VME indicator species are usually defined by a combination of life-history traits that suggest they are particularly sensitive to disturbance, or that their presence is strongly covariant with the presence of recognised sensitive species. The five characteristics that the FAO use to define a VME indicator species are:

1. Uniqueness or rarity;
2. Functional significance of the habitat[23];
3. Fragility;
4. Life history traits and;

[23] This habitat may itself be created by the indicator species

5. Habitat structural complexity creating species.

These classifications are for guideline purposes only and it is not necessary for an indicator species to score highly in all criteria. For instance, *Lophelia pertusa* (now *Desmophyllum pertusum*) is commonly regarded as an indicator species, although it is distributed widely throughout the north and south Atlantic so is not considered vulnerable because of its ***rarity***. *Desmophyllum* spp., however, qualifies as indicator species, owing to its ***fragility***, and ***functional significance***. Species life history characteristics are difficult to determine directly, since certain biological traits will co-vary with the specifics of the local environment; the same indicator species may recover much faster in the highly productive and relatively shallow NAFO fishing footprint, than on a seamount in the largely oligotrophic Indian Ocean. However, most indicator species do grow slowly, over decadal or centurial time periods, but soft bodied species like sea pens may recover a significant proportion of their biomass, post bottom-fishing impacts, in under 10 years following disturbance (NAFO pers. com.). Functional significance and structural complexity generally pertain to the capacity of the indicator species or the ecosystem it represents, to support local increases in secondary productivity and biomass of both commercial and non-commercial species. Comparative quantitative data on species and habitats for each of the RFMOs/RFBs is given in Table 2.3.

Table 2.3 – *Comparative quantitative data on VME HABITAT and SPECIES for bottom fishery RFMOs/RFBs. *Suggested by expert WG but not approved by Scientific Advisory Committee.*

VME HABITAT & SPECIES	**Notes**	**CCAMLR**	**CECAF**	**GFCM**	**NAFO**	**NEAFC**	**NPFC**	**SEAFO**	**SIOFA**	**SPRFMO**	**WECAFC**
Has a definition of VME been agreed by the RFMO?	a[24]	1	0	1	1	1	1	1	1	1	0
Is a VME species indicator list available?	a	1	0	1	1	1	0	1	0	-	0
Is a VME habitat or element indicator list available?	a	0	0	0*	1	1	1	0	0	0	1
How many species are on the VME indicator species list?	-	23	-	17*	66	41	-	13	-	0	-
Are biodiversity or habitat state indicators available?	a	0	0	0	1	1	0	0	0	0	0
What is the observed minimum water depth of VME taxa occurrence? (m)	b[25]	42	-	80	700	450	-	89	-	-	-
What is the observed maximum water depth of VME taxa occurrence? (m)	b	1,882	-	1,000	2,000	2,000	-	1,736	-	-	-
How many sperate VME Phyla have been identified?	-	5	-	7*	4	6	1	6	-	-	2
How many VME habitats (elements) have been identified?	-	-	-	6*	9	12	1	-	-	-	-
Are there any physical oceanographic features which are especially important?	a	1	-	-	1	1	1	0	1	1	0
How many fishery VME closures have been agreed	-	5	0	4	21	19	2	11	0	0	0
How many VME fishery closures occur within the fishing footprint (if one has been defined)	c[26]	5	-	4	15	11	0	4	0	0	-

[24] 1 = Yes, 0 = No.
[25] Depth in metres
[26] Includes VME fishery closures which straddle the footprint

2.4 VME impact assessment approaches

The assessment of bottom fishing impacts on VMEs is an important part of evaluating the performance of spatial management measures in minimising and mitigating the impacts of bottom fisheries on VMEs in accordance with internationally recognised norms (e.g. UNGA Resolution 61/105). Whilst most of the RFMOs/RFBs have adopted some form of spatial management measures (Table 2.4), typically through defining fishing footprints and establishing fishery closures to protect sensitive sea bed species and habitats (VMEs), the assessment of Significant Adverse Impacts (SAI) is far less advanced, and this is especially the case for CECAF, WECAFC, NPFC and SIOFA. Furthermore, where SAI methods have been developed, they typically do not address all the criteria published in the FAO guidelines (FAO, 2009), e.g. GFCM, CCAMLR, NEAFC and NAFO. Of the organisations reviewed, NEAFC and NAFO have specifically addressed some of the FAO SAI criteria, typically those concerning assessment criteria i to iii (e.g. the magnitude of impact, the sensitivity and vulnerability of VMEs and the relative extent of VME impacted against the area of VME not impacted). NEAFC, in collaboration with ICES reviews annually all available and new data on VMEs and recommends new measures to the Commission. A similar process of periodic review of conservation measures relevant to VMEs exists within NAFO on a 5-year assessment cycle. In other organisations, such as CCAMLR, although the infrastructure to record, report and act upon scientific observer VME data exists, there have not been any VME closures adopted directly as a result of these data. Nevertheless, this does not mean that the current measures adopted by CCAMLR are inadequate, and some significant MPAs have been established in recent years which protect marine resources (and biodiversity) that inevitably includes some VMEs, but the process by which protected areas are established under CCAMLR is quite different from the process followed by other RFMOs, notably; NAFO, GFCM and NEAFC.

Where surveys are lacking, it is usually due to inadequate funding to conduct dedicated investigative and exploratory surveys to identify VMEs. Therefore, RFMOs/RFBs whose CPs have limited capacity choose to direct their resources to assessing the status of fish stocks rather than assessing impacts on VMEs. A good example of where this is justified is in WECAFC, where there are large unfished areas that could potentially host VMEs, but the risk of impact is so small that expending valuable resources to determine the presence of VMEs and the potential impacts of bottom fishing in deep water areas would be inappropriate. In other RFMOs/RFBs where larger fishing vessels operate at greater depths (e.g. GFCM), or in RFMOs/RFBs with a higher proportion of areas likely to host VMEs (e.g. SIOFA and SEAFO because of their seamounts), significant gaps in the known distribution of VME poses potentially a greater risk of SAI occurring. However, in this case, both SEAFO and SIOFA, where they have relatively small demersal fishing fleets, the expected VMEs have been identified in relation to mid-ocean ridges and seamounts, but funding and capacity gaps have generally hindered efforts to assess SAIs and, particularly for SIOFA, the relatively short history of the RFMO also disadvantages it in comparison with much more well-established and developed RFMOs like NEAFC and NAFO.

Almost all of the organisations reviewed have some level of mandatory observer coverage, usually either 100% (e.g. CCAMLR) or varying levels of coverage with respect to the gear type (e.g. SPRFMO). In the case of CCAMLR this is a vital and, for the most part, cost effective means to gather data on VME species occurrence and potential VME fishery encounters. However, documenting such encounters remains very limited for other RFMOs. In addition, CECAF and WECAFC, not having RFMO status, cannot legally mandate observer coverage and currently rely on CPs (e.g. the EU regulations under the CFP extended in principal to ABNJ) to ensure some observer coverage. Nevertheless, scientific observer data are, in all cases, subject to individual skippers' decisions concerning the location, duration, type and methods of gear deployment and recovery – all of which can influence the type of catch and by-catch, which limits the quantitative use of such data for impact assessments. Accordingly, observer data is more variable than fishery independent survey data, though with a sufficiently large dataset, it can underpin valuable trends-based analyses and expose areas of relatively high VME indicator species occurrence (e.g. NEAFC).

Table 2.4 – *Comparative quantitative data on VME impact assessment methods for bottom fishery RFMOs/RFBs*

VME IMPACT ASSESSMENTS	**Notes**	**CCAMLR**	**CECAF**	**GFCM**	**NAFO**	**NEAFC**	**NPFC**	**SEAFO**	**SIOFA**	**SPRFMO**	**WECAFC**
How often are fishery independent surveys conducted?	a[27]	0.5	0	0	0.2	-	0	0	0	0	0
How often are ad hoc scientific surveys conducted?	b[28]	1	0	0.2	0.2	-	0	1	0	0	0
What sampling methods are used to assess bottom fishing impacts?	c[29]	C, D, R	-	-	B, C, D, R	C, D, R	-	C	-	-	-
Are there any studies and reports published describing VME impacts in the RFMO?	d[30]	1	0	1	1	1	0.5	0.5	0.5	0.5	0.5
How often are SAIs assessed in the RFMO?	a	0	0	0	0.2	0.25	-	0	0	0.5	0
Are observer programmes implemented to investigate bottom fishing impacts?	e[31]	1	0	0	1	1	1	1	1	1	0
% of fishing vessel trips sampled by observers each year	-	100	-	25	100	-	100	100	50	100	35

[27] 1 = less than annual, 0.5 = survey every 2 - 3yrs and 0 = no survey
[28] 1 = annual (or less than annual) and 0 = no survey
[29] B = Box core, C = Drop-down Camera or Camera sledge, D = Dredge, G = Grab, NT = Naturalist trawl, R = ROV (define others as appropriate)
[30] 1 = Yes and peer-reviewed, 0.5 = Yes but not reviewed, 0 = No
[31] 1 = Yes, 0 = No

2.5 VME identification and mapping

The primary data source of VME indicator species for several RFMOs/RFBs are from scientific observers (NPFC, NEAFC, SEAFO, SIOFA, SPRFMO, CCAMLR – see Table 2.5). All of the RFMOs have some degree of mandated observer coverage, following national or EU-level obligations. Only WECAFC is lacking any form of data collection for VME indicator species, which is mostly due to the lack of any deep-water fishing activities. Although VME bycatch data are routinely collected by scientific observers for several of the RFMOs/RFBs, the utilisation of the data, especially by NPFC, SEAFO & SIOFA, is not as advanced as that of CCAMLR, NEAFC and SPRFMO. In RFMOs which undertake routine (annual) fishery independent surveys (e.g. NAFO), VME indicator species biomass and abundance are routinely recorded and this forms the basis for identifying VMEs and VME fishery closures.

Several of the RFMOs/RFBs receive support (usually by individual Contacting Parties) in the form of dedicated, though usually *ad hoc*, research surveys. For the most part, the number of surveys and the area covered corresponds to the 'wealth' (or GDP) of the member CPs, and age of the RFMO. Predictably, CCAMLR, NEAFC, and NAFO have received some of the most research effort and funding to support VME surveys, with equivalent surveys very limited in the areas of SIOFA, SEAFO, GFCM, WECAFC, CECAF, NPFC & SPRFMO (or at least the data from relevant surveys have not been directly incorporated into the RFMO/RFB decision-making process). Typically, where surveys have been conducted, they have tended to focus on small areas which may not be representative of the habitats associated with VME from the entire RFMO/RFB (e.g. in SEAFO). The most comprehensive fishery independent survey identifying and mapping VME indicator species using habitat suitability models are associated with NAFO, which have the combined advantages of a relatively small fishing footprint and a long history of involvement from developed Contracting Parties.

Habitat suitability and species distribution models have been developed and applied in NAFO and CCAMLR. However, concerns have been raised about their use in defining the 'true' extent of VMEs, their spatial resolution being too coarse, and issues relating to their reliability. Such models have been used widely in NAFO, and attempted for NEAFC, but are considered most effective when used in conjunction with other, finer-scale data sources, including expert judgement.

Table 2.5. *- Comparative quantitative data on VME IDENTIFICATION and MAPPING for bottom fishery RFMOs/RFBs*

WME IDENTIFICATION & MAPPING	**Notes**	**CCAMLR**	**CECAF**	**GFCM**	**NAFO**	**NEAFC**	**NPFC**	**SEAFO**	**SIOFA**	**SPRFMO**	**WECAFC**
Are scientific observer data collected, recorded and mapped for VME indicator species?	a[32]	1	0	0	0	1	1	1	1	1	0
% of trips subject to scientific observer coverage		100	-	25	100	-	100	100	50	100	35
Have habitat suitability models been developed (those which include environmental and biological data)?	a	1	0	1	1	1	0	0	0	1	0
Have species distribution models been developed (which do not use environmental data)?	a	1	0	-	0	-	0	0	0	0	0
What is the total extent of mapped VME in the RFMO? (this is not the same as VME closed areas)	b[33]	357,161	0	-	33,147	-	-	155	-	-	-
Are routine fishery independent surveys conducted to sample VME indicator species?	a	0	0	0	1	1	0	0	0	0	0
How often are fishery independent surveys for VME indicator species conducted?	c[34]	0	0	0	0.2	0.2	0	0	0	-	0

[32] 1 = Yes, 0 = No

[33] Km squared. The extent of mapping depends heavily on the technique used. Given sufficient data, it is relatively straightforward to predictively map VME habitat across a large area, but focussed surveys generally cover a much smaller area.

[34] 1 = less than annual, 0.5 = survey every 2 - 3yrs, 0 = no survey

2.6 VME impact mitigation and protection

To mitigate and reduce the impacts of bottom fisheries on VMEs, all RFMOs (with the exception of CECAF and WECAFC) adopt some combination of VME fishery area closures, VME encounter protocols and exploratory fishing rules to protect VMEs. SIOFA has only adopted VME encounter protocols to date (Table 2.6).

The networks of VME fishery closures established by CCAMLR, GFCM (termed Fishery Restricted Areas or FRAs), NEAFC, NAFO, NPFC, SEAFO, SPRFMO, either prohibit all forms of bottom fishing gear or just certain types (e.g. bottom trawls). It is most likely that the absence of VME fishery closures in SIOFA is a direct consequence of it only recently being established as an RFMO, and in 2017, the SIOFA SC identified twelve candidate VME fishery closures, of which five have been recommended for consideration at the 2018 SIOFA Commission meeting[35]. VME fishery closures are typically designated based on known VME presence (VME as defined by the FAO guidelines) or seabed geomorphological characteristics typically associated with VME (e.g. seamounts and canyons). Furthermore, fishery VME closures typically represent only a proportion of the full extent (where known) of the VME present, especially where such areas coincide with a defined fishing footprint (e.g. NAFO, NEAFC). CCAMLR has designated several Marine Protected Areas which limit all forms of fishing activity, such areas are not subject to periodic review in the same way that VME fishery closures are in other RFMOs (e.g. NAFO). In most cases, it is likely impossible to directly assess whether these areas are meeting their conservation objectives, since they usually lack the requisite baseline data to determine the effectiveness of management decisions. In some cases, precautionary closures have been re-opened (e.g. in SEAFO and NAFO), though this is unusual.

VME encounters rely on fishing vessel masters reporting when they happen above certain biomass thresholds. Threshold values for what is considered an encounter are usually set by the corresponding RFMO/RFB, dependent on a combination of gear and VME types (e.g. 300 kg of sponge in NAFO and 400 kg of sponge in NEAFC). However, SIOFA presently allows individual CPs to set encounter threshold values separately. GFCM, NPFC and SPRFMO are currently considering implementing encounter rules, but have not yet agreed their implementation and consequently, reporting in these areas is at the discretion of the individual CPs. Accordingly, there are inconsistencies in how these rules are applied and enforced between the RFMOs, with some RFMOs favouring VME fishery closures rather than encounter protocols to protect VMEs (e.g. NAFO). CCAMLR is the exception, with very high levels of compliance and enforcement due to the unrestricted full reporting by scientific observers. In CCAMLR encounter protocols are the preferred approach to close relatively small areas of sea bed VME to bottom fishing activities.

Exploratory fishing rules are aimed at protecting sensitive habitats and VMEs from fishing activities outside the defined fishing footprints. All RFMOs (except SIOFA) have exploratory fishing protocols. Such protocols usually include increased scientific observer coverage, recording all of the catch contents including VME indicator species, and following a pre-approved fishing plan for consideration by the RFMO/RFB.

[35] Result of discussion unknown at time of writing.

Table 2.6. – *Comparative quantitative data on VME impact mitigation and protection approaches for bottom fishery RFMOs/RFBs*

VME IMPACT MITIGATION & PROTECTION	**Notes**	**CCAMLR**	**CECAF**	**GFCM**	**NAFO**	**NEAFC**	**NPFC**	**SEAFO**	**SIOFA**	**SPRFMO**	**WECAFC**
Are there any VME encounter rules which the fisheries use?	a[36]	1	0	0	1	1	1	1	1	0	0
How many VME encounter rules are there?	-	1	0	0	1	2	2	2	-	0	0
Have any VME encounters been reported by the fisheries?	a	1	0	0	1	0	-	0	0	-	0
Are there any VME fishery closures established?	a	1	0	1	1	1	1	1	0	0	0
How many separate VME closures have been established?	-	76	0	8	21	19	2	12	0	0	0
What is the total area of the VME fishery closures? (km²)	-	2,060,282	0	1,544,267	285,923	371,000	580	504,922	0	0	0
Are there any fishery exploratory protocols?	a	1	0	0	1	1	1	1	0	1	0
Have any exploratory fishery protocols been applied?	a	1	0	0	1	0	-	1	0	1	0
Have any notices of intent for exploratory fisheries in new fishing areas been reported/assessed?	a	1	0	-	0	1	-	1	0	1	0
How many exploratory fisheries have been approved and developed in new fishing areas?	-	5	-	-	0	0	-	1	0	1	-
Are there any gear/depth restrictions adopted as protection measures?	a	1	0	1	1	1	1	1	0	0	0
Are there any fishery footprint restrictions (freezing of the footprint) adopted as protection measures?	a	0	0	0	1	1	1	0	0	1	0

[36] 1 = Yes, 0 = No

2.7 VME long-term monitoring

In general, none of the RFMOs/RFBs have long-term monitoring plans for VMEs, with the exception of NAFO and NEAFC (Table 2.7). In NAFO, VMEs are reviewed every five years. New VME records from NEAFC are reviewed annually by ICES WGDEC, but conservation measures are reviewed with variable time intervals, ranging from 1 to 5 years. NAFO uses a combination of fisheries independent surveys and *ad hoc* research surveys to monitor the status of VME fishery closures, but concerns have been raised that the mainstay of the VME monitoring effort by NAFO is conducted using trawled fishing gears which impact the VME[37]. Accordingly, the impact of such surveys on VME is currently being evaluated. Similarly, NEAFC relies on a combination of fishery independent and *ad hoc* research surveys to evaluate the status of their VMEs, but the survey effort is less well coordinated between CPs than in NAFO, making the comparability and integration of results between surveys more difficult for NEAFC.

The overall lack of long-term monitoring and coordination of *ad hoc* VME surveys conducted by RFMOs/RFBs weakens attempts to effectively assess VME status and bottom fishing impacts (especially the assessment of SAI). However, it is noted that several of the RFMOs/RFBs have working groups which are addressing some of these concerns (NAFO, NEAFC, GFCM) and are exploring ways in which new technology may be applied to increase and improve existing monitoring and assessment activities.

[37] Fish biomass survey that also records VME bycatch.

Table 2.7. – *Comparative quantitative data on VME monitoring in bottom fishery RFMOs/RFBs.*

VME LONG TERM MONITORING	**Notes**	**CCAMLR**	**CECAF**	**GFCM**	**NAFO**	**NEAFC**	**NPFC**	**SEAFO**	**SIOFA**	**SPRFMO**	**WECAFC**
Are VMEs routinely monitored?	a[38]	0	0	0	1	1	0	0	0	0	0
How often are VMEs monitored?	b[39]	0	0	0	0.2	0.2	0	0	0	0	0
What are the sampling gears used?	c[40]	-	-	T, D, R	C, D	C, D, R, T	-	0	-	0	-
Are there any plans for the long-term monitoring of VME?	a	1	0	1	1	1	0	0	0	0	0
Are there any impediments preventing long-term monitoring of VMEs?	a	1	1	-	0	0	0	1	0	1	1

[38] 1 = Yes, 0 = No, NA = Unknown
[39] 1 = less than annual, 0.5 = survey every 2 - 3yrs, 0 = no survey
[40] C = Drop-down Camera or Camera sledge, D = Dredge, G = Grab, NT = Naturalist trawl, R = ROV, T = commercial fishing gear

2.8 Comparative RFMO/RFB meta-data analysis

For each of the topics (e.g. organisational structure; fishery resources and information relating to sensitive species and habitats) reviewed (see Section 1.3), the responses given against each of the the questions (as tabulated in sections 2.1 – 2.7) where appropriate have been evaluated and classified against three overall assessment categories, 'Capacity', 'Action' and 'Need'. These categories are described below:

Category Type	Definition
Capacity	What a RFMO/RFB has authority and resources to deliver.
Action	What a RFMO/RFB has put into practice.
Need	What a RFMO/RFB should or needs to do.

These assessment categories are collectively referred to as CAN (Capacity, Action and Need) scores in the following analysis. For example, a "capacity" score would be assigned a higher score if the organisation was mandated as a Regional Fisheries Management Organisation, as opposed to a Regional Fisheries Body, thereby giving it legal authority to implement fishery management measures by which CPs must abide. Furthermore, an "action" score would be assigned a higher score based upon the implementation of conservation and enforcement actions taken by the RFMO/RFB (e.g. the proportion of the fishable area that is closed to bottom fishing); and finally, the "need" scores relate to an actual or perceived need for action, e.g. the amount of fishing effort, number of stocks **not** assessed or the extent of unmapped sea bed for VME. Some of the "need" scores are derived from the "action" responses, e.g. a low or zero mandated observer coverage infers a ***need*** to improve observer coverage, and so can be considered a contribution to the "need" score. All scores are relative; a high score merely indicates that an RFMO/RFB is performing better than others that have a comparatively low score with respect to a specific attribute. It does not necessarily mean that best practice has been adopted or that improvements are not needed.

It should be noted that not all question responses can be assigned to a CAN score. For example, a low score for "*typical stock assessment interval*" could be as a result of low "capacity" to conduct assessments, or because an increased assessment interval is not necessary. These type of question/response ambiguities and questions that had too few responses from the RFMOs/RFBs (e.g. less than 8 out of 10) were excluded from the comparative analysis. Scores were also weighted according to the number of responses that could be completed; a high number of missing fields decreases a ***capacity*** or ***action*** score, but increases the ***need*** score. A list of the questions assigned to CAN scores used in the present analysis is provided below:

Capacity: The potential of a given organisation to enact new measures, or improve existing measures, for managing deep-water fisheries:

- Is the organisation a RFMO?
- How many member states/ contracting parties does the RFMO/RFB have?
- Does the organisation have a secretariat?
- How many personnel are based in the secretariat (FTEs)?
- How many working groups exist within the organisation?
- How often do working groups meet?
- What is the annual budget of the organisation?
- What proportion of fishing vessels provide positional data?
- What is the interval which vessels log their position?
- Are there demonstrable plans for future monitoring and/or research programmes?

***Action*:** The extent to which an organisation has responded to an opportunity to implement management measures[41]:

- Are data collected on target species, non-target species (i.e. species not targeted, but retained for commercial gain) and bycatch species (i.e. non-target species of no commercial value)?
- How many stocks are assessed, and what proportion of stocks have quantitative measures of stock status?
- Is vessel position data utilised by the organisation?
- What are the levels of observer coverage, and the amount of observer data collection?
- Have VME indicator taxa been defined and their habitats mapped, either from dedicated surveys or observer reports?
- Has the distribution of VME indicator taxa or their habitats been subject to distribution modelling?
- Does the organisation have a defined fishing footprint?
- Does the organisation implement exploratory fishing protocols?
- Does the organisation implement VME encounter protocols?
- Has the organisation defined, and assessed, significant adverse impacts?
- Has the organisation conducted fishery independent surveys of VME and/or fish stocks?
- What is the number and size of bottom fishing closures, within and outside of the fishing footprint?
- Has the organisation developed and implemented fishery technical measures to control fishing impacts (e.g. gear restrictions)?

Need: The questions in this category are more closely related to scoring 'residual need', e.g. given the policies, measures and capacity of the organisation, what aspects of management may require improvement.

- What is the proportion and absolute area of the organisation's area of competence subject to bottom fishing activity?
- What is the number of target and non-target species that require assessment and management?
- What is the depth range in which fishing is permitted?
- What is the total fishing effort and size of the fleet?
- What type and number of fishing gears are permitted for use in the organisation's area of competence?
- What is the total extent of the area of competence?
- Is scientific observer coverage adequate for the assessment needs?
- Have VME species or habitats been identified?

The matrix of compiled data was standardised by its range of values (where 1 = the maximum value for a given criterion) in order to remove any bias in the comparative analysis caused by differences in scales of variable measurement and quantification. No additional transformations were applied prior to, or during, the multivariate analyses presented in section 2.9.

2.9 Results

It may be expected that as a RFMO/RFB ***capacity*** and ***action*** scores increase there will be a commensurate decrease in their ***need*** score – essentially reflecting the fact that as more ***action*** is taken the ***need*** for further action tends to decrease, and indeed this is what is generally observed (Fig. 2.9.1),

[41] Some criteria amalgamated for the purposes of being concise.

albeit the trend is not statistically significant (Spearman's Rank: p = 0.12 and 0.31 respectively). The lack of significance may partially be attributed to the small sample size and the binary/categorical nature of some of the criteria scores. However, it can be seen that several of the RFMOs/RFBs are either above or below the mean trendline (the level of residual ***need*** expected, given current ***capacity*** and historic ***actions***). It is notable, that CECAF is well above the trendline, but since it is not a RFMO it still has to rely upon the goodwill and cooperation of individual CPs as it has no legal mandate to enforce any adopted measures. This suggests that, at least until CECAF becomes a RFMO, CECAF CPs need to do considerably more to effectively manage their fisheries and protect VMEs. By contrast, SEAFO is situated well below the trendline (as is SIOFA and CCAMLR) suggesting a level of higher relative performance. In the case of SEAFO this is largely because of it is relatively extensive network of established (mainly precautionary) bottom fishing closures, and the low levels of fishing effort it experiences in its area of jurisdiction. This assertion is further supported by examining the relationship between ***action*** and ***capacity*** (Figure 2.9.2) which shows SEAFO has a relatively high ***action*** score for a relatively low ***capacity*** score. By contrast, NAFO, NEAFC, and CCAMLR are all consistently highly scored for both ***action*** and ***capacity*** reflecting their relatively wealthy status. Nevertheless, there are some interesting differences between the ***need*** scores of NEAFC, CCAMLR, and NAFO which separates them in terms of their performance. For example, the ***need*** score of NEAFC is higher than NAFO which in turn is higher than CCAMLR, suggesting that NEAFC has more to do in meeting its fishery management and VME protection obligations compared to NAFO and CCAMLR, but again it should be noted this assertion is based only assessing the metrics included in the present analysis, so it is limited to available information, and potentially biased.

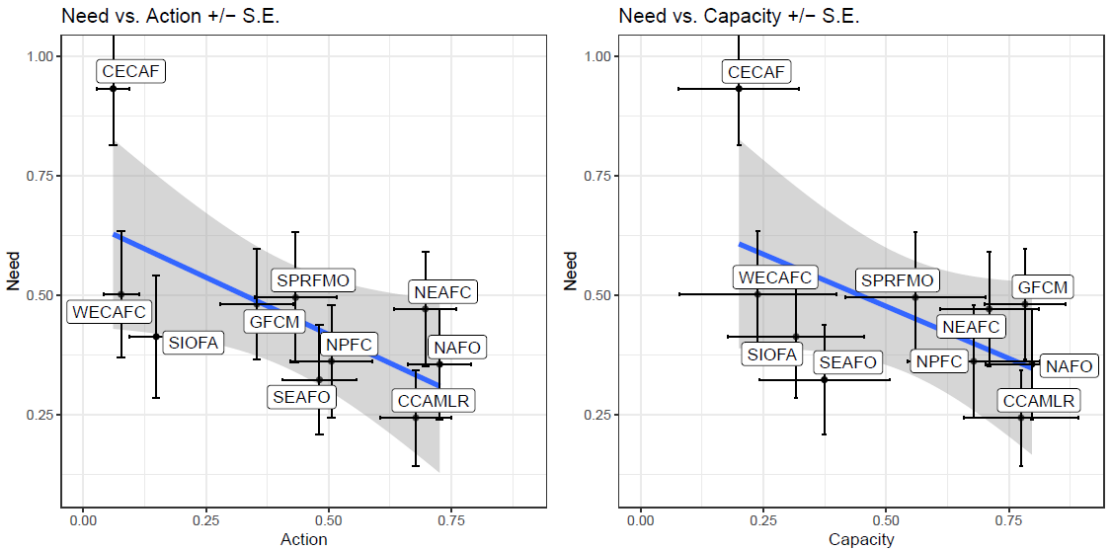

Fig. 2.9.1 – Comparisons of the 'capacity', 'need' and 'action' scores +/- S.E. Grey area = S.E. of linear model.

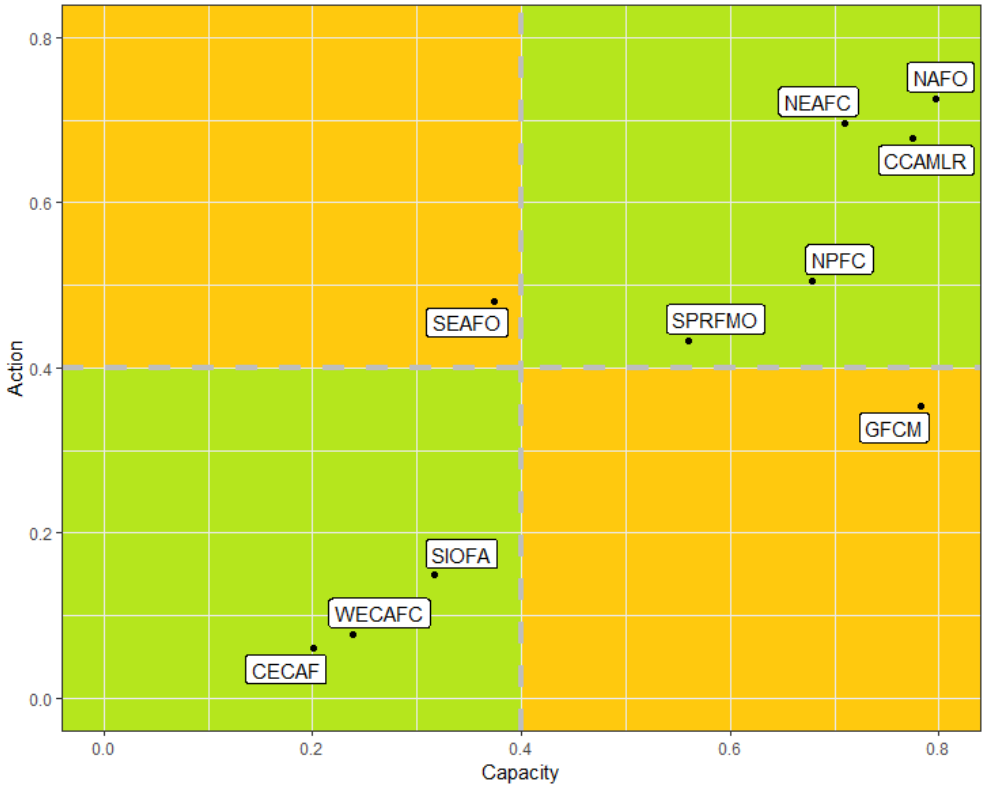

Fig 2.9.2 – Relative performance of RFMOs/RFBs based upon ***Capacity*** and ***Action*** scores. The green quadrants represent RFMO/RFB optimal performance, e.g. the level of ***action*** is commensurate with levels of ***capacity.*** By contrast the yellow areas represent potential non-optimal performance, either in terms of over (top left), or under (bottom right) performance.

It is noteworthy that the proportion of CPs that are developed and relatively wealthy countries, and therefore more likely to enforce robust environmental regulations with increasing legal obligations for reducing the ecosystem impacts of fishing[42], are more likely to directly contribute financially and *in kind* to the work of a RFMO/RFB. RFMOs/RFBs with the greatest ***action*** scores also tend to have the greatest proportion of developed and wealthy countries as CPs and so would be expected to have the most comprehensively developed and enforced fishery management and VME protection measures (Fig. 2.9.2).

Clearly, a comparative analysis of the RFMOs/RFBs performance with respect to fisheries management and protection of VMEs is a multi-dimensional and nuanced task, influenced not least by the need for ***action*** and ***capacity*** of an organisation to respond to such needs. It is therefore important to understand, it is likely that no single process or method proposed for fisheries management or the protection of VMEs, is likely to be applicable across all RFMOs/RFBs.

To further explore and better understand the variation between RFMOs/RFBs, we performed a Principal Components Analysis on the collective CAN scores, comprising the responses to the questions given in Tables 2.1 – 2.7. The resultant PCA (Fig. 2.9.3) helps to objectively identify those RFMOs/RFBs that are most similar to each other, and to better understand the factors which drive their relatedness. It can be seen that most of the variation between the RFMOs/RFBs can be explained by PC1 (41%) which correspond to differences in a number of VME related scores. For example, WECAFC, CECAF and to a lesser extent SIOFA have very few if any VME closures, VME encounter protocols, mapped VME or a defined fishing footprint. Some (but not all) of these attributes are actioned in GFCM, SPRFMO &

[42] For example, where domestic legalisation demands a higher observer coverage than the organisation's conservation measures.

SEAFO, but it is NEAFC, NAFO, and CCAMLR which score most highly in these attributes. It is in this respect that NEAFC, NAFO, and CCAMLR are quite clearly different from all other RFMOs/RFBs.

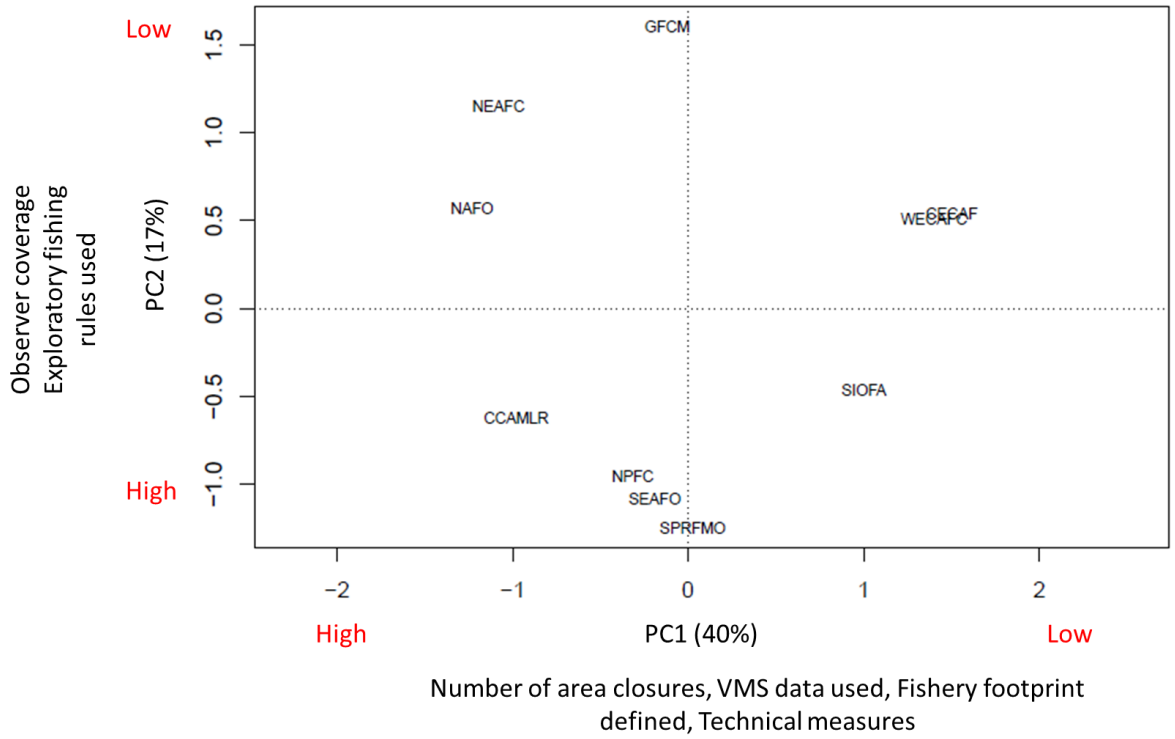

Figure 2.9.3. Principal Components Analysis ordination plot showing the (dis)similarity between RFMOs/RFBs. In this analysis, missing values are given as zero.

It is also apparent from Figure 2.9.3 that several clusters of RFMOs/RFBs exist, such that CCAMLR, NPFC, SPRFMO and SEAFO show some similarities, NAFO and NEAFC are also similar, as are WECAFC and CECAF. However, GFCM and SIOFA are essentially outliers, caused by GFCM having relatively high ***capacity*** score, but correspondingly relatively low ***action*** score (Fig. 2.9.2), whereas SIOFA has both a relatively low 'capacity' and 'need' (Fig. 2.9.2). For SIOFA, the low need is caused by the relatively low fishing effort, targeting only few fish species and the low capacity score is driven by it having few staff in the Secretariat, few working groups, low budget and no plans for monitoring. In part, the different RFMO/RFB groupings (Fig. 2.9.3) can be explained by differences in their area of jurisdiction and the proportion of developed 'wealthy' CPs as members of each RFMO/RFB (Table 2.9.2). It is also noteworthy, that GFCM is the only RFMO to operate from inshore to offshore areas, and only within national jurisdictions, and is subject to a very complex blend of national and multi-lateral legal instruments. GFCM also has by far the highest demersal fishing effort (some 12 to 24 times greater effort than NAFO or NEAFC, and several orders of magnitude greater than SEAFO, NPFC or SPRFMO). By contrast, CCAMLR has no bordering countries, except for remote, uninhabited islands e.g. South Georgia and the South Sandwich Islands (UK), or Bouvet Island (France), resulting in fleets being entirely composed of large industrialised vessels.

Table 2.9.2 – Grouping organisations in terms of the development status of their member states and their regulatory role. ABNJ = Areas Beyond National Jurisdiction.

	Low proportion of developed CPs (<0.6)	Moderate proportion of developed CPs (0.6 – 0.8)	High proportion of developed CPs (>0.8)
Operates in ABNJ (high seas regulatory area)	SIOFA	SEAFO SPRFMO	CCAMLR NAFO NEAFC NPFC
Operates both within and beyond areas of national jurisdiction.	CECAF WECAFC	GFCM	

Overall NAFO, NEAFC and CCAMLR are the most consistently high scoring organisations in terms of their ***action*** and ***capacity*** scores relative to the other RFMOs/RFBs assessed. The attributes they tend to exhibit are highlighted in Table 2.9.3. By contrast low or moderate scoring RFMOs/RFBs (e.g. CECAF, WECAFC and SIOFA), tend to demonstrate low ***capacity*** scores driven, in part, by a lack of financial and staff resources (Table 2.10.3), and by a lack of regulatory powers. Nevertheless, SEAFO although scoring poorly in capacity, still performs above the level expected with regard to ***actions*** it has delivered (Fig. 2.9.2).

Table 2.9.3 – Typical characteristics of high and low-moderate scored organisations.

Relatively high scoring organisations NEAFC, NAFO, CCAMLR, SEAFO	Relatively low-moderate scoring organisations[43] CECAF, SIOFA, WECAFC
High standards of data collection for target fish stocks.	The organisation has only recently been established or does not have RFMO status.
Vessel position data used.	Low numbers of permanent staff in the secretariat.
VME species/ habitats identified, and habitat suitability models developed.	The secretariat has a relatively low budget.
Fishing footprint defined.	The secretariat has few working groups.
Fishery closed areas implemented, both within and outside of fishing footprint.	Few stocks are assessed.
Studies of SAIs have been conducted.	Observer coverage is low or not mandated.
VME encounter rules have been adopted.	Lack of fishery independent surveys.
Technical measures restrict gear usage.	Fishing footprint is not defined.
VME monitoring plans are in place.	

A number of the RFMOs reviewed here have also been the focus of two earlier reviews (Lodge *et al.,* 2007; Cullis-Suzuki and Pauly, 2010), e.g. CCAMLR, GFCM, NAFO, NEAFC, SEAFO, SIOFA[44]. These reviews focus more upon the performance of individual RFMOs in terms of their administrative governance and management of fish stocks, rather than the mitigation/avoidance of seafloor ecosystem impacts, though some comparable data are presented as part of the present report, to give a broader context and facilitate further comparisons. The present study CAN scores is analogous to the

[43] In addition to scoring low in criteria symptomatic of higher scoring organisations.

[44] Lodge et al., 2007 & Cullis-Suzuki & Pauly 2010 also include a number of other organisations, such as: salmon & anadromous fish commissions (e.g. NPAFC); tuna commissions (e.g. ICCAT), single species commissions (e.g. CCBSP) and others like the IWC.

'P' and 'Q' scoring method used by Cullis-Suzuki and Pauly (2010)[45] and there was general agreement in the trends for some RFMOs (comparable to Fig. 2.9.2). In Cullis-Suzuki and Pauly (2010), both CCAMLR and NEAFC scored highly in theoretical performance (e.g. '***Capacity***') and actual performance (e.g. '***Action***') and GFCM, whilst scoring highly for theoretical performance in both reviews, also scored less well for actual performance. Most of the RFMOs reviewed here were not scored in both categories by Cullis-Suzuki and Pauly (2010).

The patterns and relationships between different RFMOs can also be assessed and visualised by examining the individual question responses for each of the RFMOs/RFBs as shown in Figure 2.9.3. There are a number of commonalities between different attributes used to assess the RFMOSs/RFBs criteria (Fig. 2.9.3). For instance, organisations that have defined a footprint, have also implemented exploratory protocols and use observer data to monitor and assess impacts upon VME. Some criteria are strongly co-variant (e.g. older, better funded organisations tend to have more staff, and quantitative stock assessments, or an organisation that conducts scientific surveys tends also to conduct VME monitoring). The strongest pairings between organisation are between NEAFC and NAFO; and CECAF and WECAFC; these pairings share the same legal status, and similar geographic areas and operational histories. There is also a clear difference between the grouping of SIOFA, CECAF and WECAFC and all other RFMOs.

[45] P = Performance in theory; Q = Performance in practice. Similar in concept to Capacity and Action respectively.

Figure 2.9.3 – Interactions between RFMOs and different category scores. Average linkage cluster dendrograms (Euclidean distance) used to order the plot, with colour indicating the weight of score in each case (yellow = high, dark blue = low). Spp = species; HSM = Habitat Suitability Model; SDM = Species Distribution Model; VMS = Vessel Monitoring System. N.B. Criteria with too few scores, or where all organisations scored zero, are not included.

The re-evaluation of the VME fishery closures is common practice across RFMOs/RFBs, such that where closures have been established, they are often subject to periodic review. However, there are very

few instances of where a closure has been re-opened following such a review. The authors are aware of only one instance where this has occurred which was NAFO VME Area Closure 14' (sea pen), which was re-opened in 2019, following a two-year temporary closure[46] to allow new data to be gathered on sea pen biomass in the area to evaluate its expected status as a VME.

In practice, closures are either implemented because of documented occurrence of VMEs, an option only open to some RFMOs (i.e. NEAFC, CCAMLR or NAFO), or they are closed as a precaution, usually owing to the presence of particular topographic feature that might be expected to host high VME abundance, such as a seamount (e.g. SIOFA and SEAFO). There is little basis to reconsider area closure networks in the former, but in the latter, where VMEs may not have been directly confirmed, proposed fishing activities may be considered akin to exploratory fishing. In such situations, it would be preferable to conduct scientific surveys and appropriate modelling studies in advance of fishing activities, to improve the spatial understanding of the threat posed by fishing and provide a basis to reclassify the closed area network. In any case, the re-opening a closed area ought to be preceded by the presentation of new data that can confirm that the risk to VMEs is lower than previously thought. In practice, this would likely be a submission to the Scientific Committee, who would then offer advice to the Commission as to the usefulness of the new observations.

Although the majority of VME protection measures focus upon methods for defining and implementing closed areas and fishing footprints, other management options are also available for fishery management organisations (Fig. 2.9.4). The likeliest source of SAIs is generally regarded to be mobile, bottom-contacting gears, such as otter trawls, and by limiting the areas in which these activities may occur, the risk of adverse impacts may be substantially reduced. Gear-specific closures exist in certain organisations, such as the longline only areas in SEAFO, or the moratorium on trawling in waters deeper than 1000m in GFCM. Depending upon the target species, it may be possible to further mitigate impacts through gear modifications (e.g. different demersal longline configurations), though clearly there is a balance to be struck in terms of adverse impacts upon other ecosystem components (e.g. seabirds).

[46] NAFO 2018 CEM: https://www.nafo.int/Portals/0/PDFs/COM/2018/CEM-2018-web.pdf?ver=2017-12-21-133002-477 – Area 14 closure (CEM II-17.3b) expired on 31/12/2018 and not renewed.

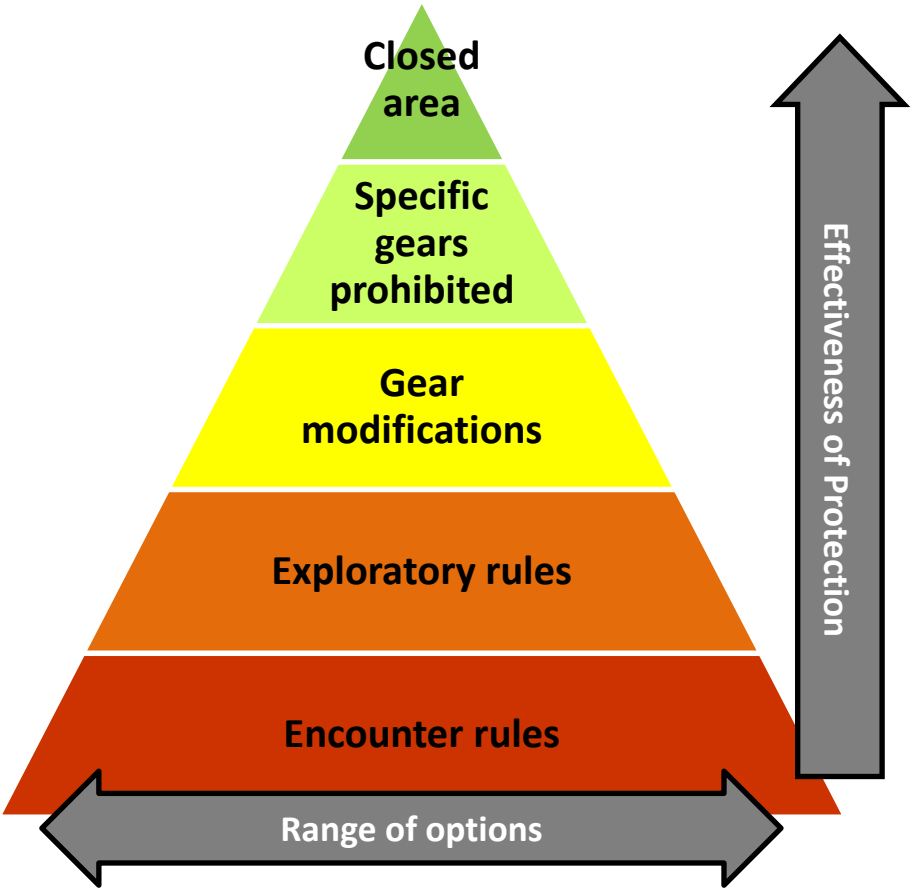

Figure 2.9.4 – Conceptual hierarchy of fisheries management measures available to organisations to mitigate or avoid adverse impacts upon VMEs in a given area. Effectiveness of encounter rules varies according to observer coverage levels and expected duties. N.B. Hierarchy is not mutually exclusive (e.g. an organisation might opt to have exploratory rules that prohibit certain gear types or configurations).

3. CONCLUSIONS

1. The CAN scores presented here are a relative measure only, and we reiterate that a good score does not necessarily equate to good management. It is evident from the analysis presented here that direct comparisons between any pair of organisations is difficult to make, owing to the considerable role of factors such as the legal status and age of the organisation, and the proportion of members that have the ability to provide independent research to support the work of any one of the RFMOs/RFBs (e.g. the Norwegian 'Nansen' Ecosystem Research programme in support of CECAF and SEAFO). However, within the confines of these considerations, useful comparisons (at least relatively speaking) can be made in terms of the performance of individual organisations.

2. In general, planned or future measures have not been explicitly included in the present analysis since it was not possible to evaluate their likely effectiveness, or be confident in their outcomes, but at the time of writing, SIOFA is considering implementation of a number of bottom fishing closures which will likely bring its performance more in line with higher scoring RFMOs (e.g. SEAFO).

3. Landings data were often very difficult to obtain and when available, different data sources were not in agreement. For instance, the NAFO data portal is deemed not to be accurate (IEO, pers. comm.) due to poor compliance amongst CPs in terms of submitting data. For example, the two versions of the reported data do not agree and reported landings in 2014 are around 10% of the preceding three years, as well as in 2015, with no explanation given in the portal. In the case of NAFO, this is explained by the fact that data submission for evaluation and informative purposes follow entirely different channels and submission to STATLANT is not mandatory. Thus, CPs often do not submit their catch data on time and there is poor confidence that the annually distributed FAO guidance for the preparation of these catch figures (STATLANT) is adhered to by all. GFCM has similar issues with online catch and landings data reliability published on its website.

4. The review highlights instances where organisations are failing to enact measures to conserve deep-water stocks and member states self-awarding TACs, which seriously compromises the organisation's capacity to deliver its stated objectives.

5. The most common SAI avoidance/ mitigation measures are area closures, and encounter and exploratory rules. Closed areas undoubtedly have the greatest potential to reduce adverse impacts but also reduce the size of the fishable area and can potentially concentrate fishing effort in other areas, increasing the risk of serial depletion of local resources. In such cases, it may be preferable to close areas only to specific gear types with the greatest risk of incurring SAI (e.g. bottom trawling). The extent to which other measures are adopted, e.g. technical measures for gear set up, is less clear but could be a valuable tool.

6. The effectiveness of proposed measures may be compromised where organisations use a consensus ruling approach, which forces proponents of new conservation measures to continually dilute their proposals before they can gain enough support. Such concerns were not directly captured within the (publicly available) data.

7. In NEAFC and some other organisations, observer coverage is limited and only mandated by a small number of CPs which, when combined with the well-known culture of hostility towards fishery observers, creates considerable concern over the quality of the resultant data and ability to document accurately VME encounters. Accordingly, it may be expected that VME encounters are often under-reported, if reported at all. Concerns over relatively low fisheries VME encounter reporting, in part, resulted in more effort directed to establishing VME fishery closures in NAFO. Issues with observer coverage (at sea and port inspections) also extends to

a suite of other compliance and enforcement challenges, as well as limiting the data available to support stock assessments and the assessment of SAI.

8. In all RFMOs/RFBs (with the exception of CCAMLR) there is a need to ensure that observers are free to carry out their full scientific recording duties, but this is difficult to ensure in fisheries that are geographically remote, or where there is a high proportion of effort or catch by artisanal fleets.

9. Pursuant to the UN General Assembly resolution on the management of deep-sea fisheries, and their impact upon sensitive fauna, all of the RFMOs review have the included some degree of goal to mitigate or avoid such impacts. However, whilst some organisations do well to address this under a precautionary approach (e.g. SEAFO), there are others which have so far done relatively little, even despite a long history (e.g. GFCM) or rely too heavily upon measures that are difficult to enforce, such as encounter rules. Observers have limited time and are not present during all fishing activities, but the advent of technology that allows catches to be monitored autonomously and later reviewed may prove a useful means to mitigate this gap in compliance monitoring.

4. RECOMMENDATIONS

The findings of this review merit the following recommendations for consideration by the European Commission:

1. In order to maximise the value of the information and data collated and reviewed as part of the present study – specific questions could be identified and addressed, e.g. *what are the most appropriate methods for establishing VME fishery closures given a range of data limited circumstances experienced by RFMOs/RFBs*? The compilation of responses to specific questions could form the basis of a best practice guidance document for EU fisheries in the high seas.

2. Those RMOs/RFBs assessed to be relatively low or moderately performing (e.g. CECAF, WECAFC and SIOFA) do require proportionally more support to build capacity (financial, and technical expertise) than higher performing RFMOs. One-off *ad hoc* R&D surveys which can map areas of sea bed and conduct a range of habitat and species sampling (including fish) can generate invaluable data to initiate appropriate impact risk assessments and the protection of VME in data limited areas. Such surveys should be given high priority of support.

3. Improved methods to ensure compliance amongst CPs fishing activities within an RFMO/RFB area of competence, and to use most, if not all, fishing vessels as platforms for objective data acquisition on catches and habitat status, should be investigated. The use of new technologies may be helpful in this respect (e.g. digital log-books, VMS data logging, AIS data logging, onboard CCTV imagery, remote satellite imagery). A specific evaluation of the role and application of such technologies to support RFMO/RFB compliance of conservation and enforcement measures would be beneficial.

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ANNEXES

RFMO AND RFB DESCRIPTIONS

A1.1. CCAMLR

A1.1.1. Organisation, Data and Governance

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) was established by international convention in 1982 with the objective of conserving Antarctic marine life[47]. As such it is not a Regional Fisheries Management Organization (RFMO), but an organization responsible for the conservation of marine life in the Southern Ocean, which includes management of Antarctic fisheries. The Convention Area of 35,716,100 km^2 roughly follows the Antarctic convergence, representing about 10 percent of the Earth's ocean surface area (Fig. A1.1.1).

[47] https://www.ccamlr.org/en/organisation/convention

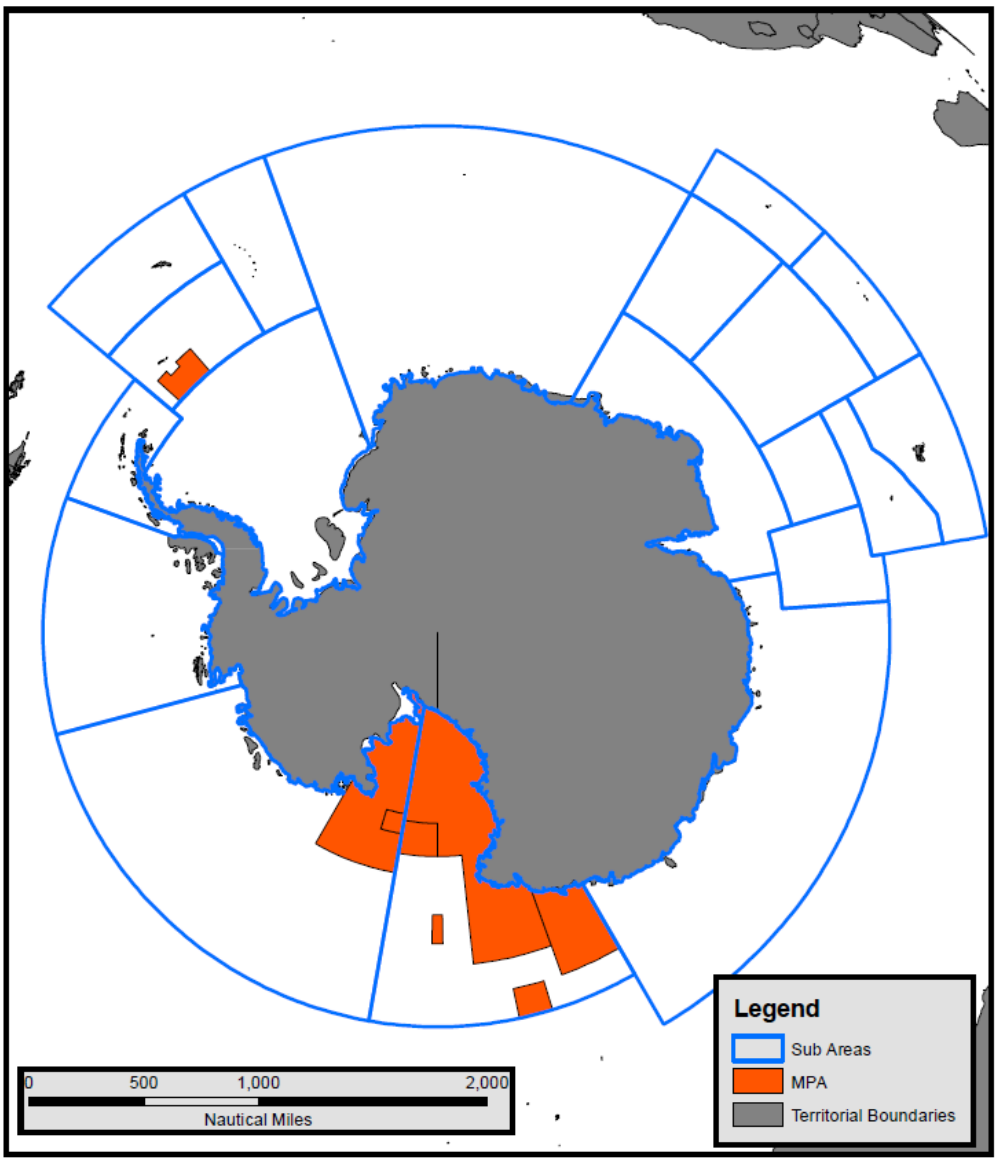

Figure A1.1.1 – CCAMLR sub-areas and current MPAs (not including MPA network declared by the Government of South Georgia and the South Sandwich Islands).

The Convention sets out principles of conservation that promote the rational use of marine living resources and are implemented through Conservation Measures.

CCAMLR is part of the Antarctic Treaty System and was originally conceived in 1977 when Parties to the Treaty agreed to set up a Convention to prevent the overexploitation of krill, which was being fished heavily at the time. The main concern was that a collapse of krill stocks would have a subsequent effect on the recovery of predators, specifically whales and seals, and its remit was to balance the demands of fisheries with the requirement to ensure that there were no negative effects on the Southern Ocean ecosystem. CCAMLR was the first international Antarctic convention to cover fisheries, others had previously covered mammals and are excluded from the management of CCAMLR (IWC – whales, CCAS – seals). The convention was signed in Canberra, Australia in 1980 by the initial 14 Contracting parties (Australia, Argentina, Belgium, Chile, France, Germany, Japan, New Zealand, Norway, Poland, Russia, South Africa, United Kingdom and United States of America) and the first meeting was held in 1982.

A CCAMLR Contracting Party is a State, or a group of states, which has committed to the Convention through ratification, acceptance, approval or accession. Members include those Contracting Parties

that participated in the first meeting at which the Convention was adopted in 1980, as well as States that have subsequently acceded to the Convention and been accepted as Members by CCAMLR. The Convention is open for accession by any State interested in research or harvesting activities to which the Convention applies. Acceding States do not take part in the decision-making process of the Commission nor contribute to the budget. There are currently 25 Members and 11 acceding States (Table A1.1.1).

Table A1.1.1 – List of Members and Acceding States to CCAMLR. **major fishing nation; *minor fishing nation, others - research interests only (Compiled from CCAMLR Website)[48].

Members of The Commission (17 Fishing, 7 Non-Fishing Plus EU)			
1	Argentina*	14	Namibia
2	Australia**	15	New Zealand**
3	Belgium	16	Norway*
4	Brazil	17	Poland*
5	Chile**	18	Russia**
6	China	19	South Africa*
7	European Union	20	Spain**
8	France**	21	Sweden
9	Germany	22	Ukraine**
10	India	23	United Kingdom**
11	Italy	24	USA
12	Japan**	25	Uruguay*
13	Korea, Republic of**		
Acceding States			
1	Bulgaria	7	Netherlands
2	Canada	8	Pakistan
3	Cook Islands	9	Panama
4	Finland	10	Peru
5	Greece	11	Vanuatu
6	Mauritius		

Article II of the convention lays out the three main principles of conservation that govern the decisions made by CCAMLR, these are:

(a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment. For this purpose, its size should not be allowed to fall below a level close to that which ensures the greatest net annual increment;

[48] https://www.ccamlr.org/en/organisation/membership

(b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources and the restoration of depleted populations to the levels defined in sub-paragraph (a) above; and
(c) prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem and of the effects of environmental changes, with the aim of making possible the sustained conservation of Antarctic marine living resources.

CCAMLR employ both an ecosystem based and precautionary approach to the management of marine resources. They define the purpose of ecosystem-based management to:

> *'regulate fishing for selected target species while ensuring that fishing does not adversely impact other species that are related to, or dependent on, the target species.'*

The aim of the precautionary approach is to minimise any long-term adverse effects due to the harvesting of marine resources, specifically it is to:

> *'preserve the "health" of the ecosystem by setting conservative (i.e. precautionary) catch limits to take account of the needs of harvested and associated ("dependent and related") species.'*

The precautionary approach forms the basis for setting the total allowable catches (TACs) of the target species plus any rules regarding bycatch, for example move on rules or closing areas if by-catch limits are exceeded.

The Commission is the decision-making body of CCAMLR and is made up of representatives of all the Member States. It determines the catch levels in the Convention Area, based on advice from the Scientific Committee and introduces measures to reduce the potential impacts on non-target species.

The Scientific Committee is directed by the Commission and advises on the catch levels and other management measures. It is in turn advised by a number of standing Working Groups (WG). The two most relevant working groups for VMEs are WG-FSA (Working Group for Fish Stock Assessment) and WG-EMM (Working Groups for Ecosystem Monitoring and Management).

WG-FSA was formed in 1984, the original terms of reference were developed by the Scientific Committee to:

a) Assess the status of fish stocks in the Convention Area.
b) Advise on Management Measures required to meet objectives, taking into account requests made by the Commission.
c) Identify research and data collection priorities which would be required for improved stock assessments.
d) Submit reports to Scientific Committee which assist the Commission when considering management measures that may be necessary.

In addition, the WG-FSA now provides advice on aspects of the effects of fisheries on non-target species including vulnerable marine ecosystems (VMEs), data collection by scientific observers and approaches to the precautionary management of data-poor fisheries. WG-FSA meets annually at the CCAMLR Secretariat immediately prior to the meeting of the Scientific Committee in late September or early October.

WG-EMM was formed in 1995 and was an amalgamation of two working groups, WG-Krill and WG-CEMP (CCAMLR Ecosystem Monitoring Programme). The terms of reference for WG-EMM are:

i. Assess the status of krill stocks.
ii. Assess the status and trends of dependent and related populations.
iii. Assess the environmental features and trends which may influence the abundance and distribution of harvested, dependent, related and/or depleted populations.
iv. Identify and coordinate research necessary to obtain information on predator/ prey/ fisheries interactions.
v. Liaise with WG-FSA on stock assessment related matters.
vi. Ensure continuity in CEMP.
vii. Taking into account assessments and research develop management advice on the status of Antarctic marine ecosystems and for the management of krill fisheries in full accordance with Convention Article II.

In addition, WG-EMM also provides advice on aspects of spatial protection, including MPAs and VMEs. It meets annually around June or July and is hosted by a CCAMLR Member.

The other main WG is WG-SAM (Stock Assessment Methods) which became a standing working group in 2006 and is responsible for reviewing the technical assessments and modelling issues relevant for all working groups. WG-SAM meets annually after WG-EMM. WG-IMAF (Incidental Mortality Associated with Fisheries) was formed in 1993 to look at the emerging issue of bird and mammal mortalities. A number of measures have been introduced to reduce these to minimal levels. Following sustained reductions in mortality, the WG was no longer considered necessary and any issues are now dealt with by WG-FSA (SC-CAMLR-XXX, 2011). It held its last meeting in 2011.

There are also *ad-hoc* groups and workshops, of which the most relevant to this study is the Ross Sea Region MPA Research and Monitoring Plan Workshop, held in Rome in April 2017. This was convened to develop a management and research plan for the newly declared Ross Sea MPA.

Article IX of the Convention outlines how the Commission can manage the fisheries in accordance with Article II. It states that the Commission must base any decisions on the best scientific advice available and that they must be reached by consensus. It also outlines how the controls on fisheries are embedded in the Conservation Measures, which are binding on all signatories. New Conservation Measures, or changes to existing Conservation Measures, become binding 180 days after first notification.

Conservation Measures (Table A1.1.2) give the regulatory framework for the fisheries and research that take place in the Convention Area and provide guidance on data requirements to support development of Management Advice by the Scientific Committee. They enable the collection of data for scientific analysis to ensure fisheries cannot expand faster than the acquisition of information for the development of Management Advice.

Table A1.1.2 – Classifications of different Conservation Measures[49]

Compliance (Preceded with 10)	Marking of vessels and gear, Licensing and Inspection Port inspections (toothfish), VMS (all fisheries except krill) Catch Documentation Scheme (toothfish) Schemes to promote compliance by CPC vessels and CP nationals

[49] Based on https://www.ccamlr.org/en/system/files/e-schedule2017-18_0.pdf

General Fishery Matters (Preceded with 20 – 26)	Notification of a new fishery Participation in an Exploratory fishery Mesh size limits and Measurement of mesh size Data reporting systems Research exemption and Experimental fishing Minimisation of incidental mortality
Fishery Regulations (Preceded with 31 – 33, 41 – 43, 51 – 52 or 61)	Fishing seasons, closed areas, prohibition of fishing, Bycatch limits Conservation measures for specific fisheries: toothfish, icefish, krill, crab and squid
Protected areas (Preceded with 91)	CEMP (CCAMLR Ecosystem Monitoring Programme sites)

In addition to the conservation measures outline above, which are binding on all Members, there are also a number of resolutions that are not binding but are designed to complement the conservation measures, and members are encouraged to implement the resolutions where possible. In 2018 there were 69 active Conservation Measures and 21 Resolutions in place. Three Conservation measures were specifically developed in response to the UNGA Resolution 61/105, paragraph 83, these are summarised below.

i. CM 22-06 *Bottom fishing in the Convention Area* (2017) requires that all proposals, to undertake bottom fisheries, contain an assessment of the potential for, and measures to, mitigate against any negative impacts on VMEs. All such proposals are then reviewed by the Scientific Committee, which then advises the Commission accordingly.

ii. CM 24-01 *The application of conservation measures to scientific research* (2017) mandates Contracting Parties undertaking fishery-based scientific research activities on the effects of bottom fishing to submit a research plan for review by the Scientific Committee and Commission. CCAMLR has also agreed a format for notification of VMEs encountered during scientific research cruises. Two such notifications were made in 2017 (CCAMLR 2008).

iii. CM 22-07 *Interim measure for bottom fishing activities subject to Conservation Measure 22-06 encountering potential vulnerable marine ecosystems in the Convention Area* (2013) clearly defines an encounter with a VME during fishing operations and describes the resulting course of action to be taken by a vessel.

CCAMLR is financed by the Member States through Member's fees which are set according to Article XIX of the Convention. This states that each member of the Commission shall contribute towards the budget according to the amount harvested and an equal share among all Members, the proportion in which these two criteria apply will be decided by the Commission. During 2017, Members' contributions were between around €80,000 - €90,000 each, the annual budget for 2018 is around €4,000,000. The annual budget is approved by the Commission based on advice from the Standing Committee on Administration and Finance (SCAF), budget management is governed by the financial regulations[50].

CCAMLR has established relationships with a number of RFMOs and Conservation organisations and send observers to their annual meetings, the organisations are:

- The Agreement for the Conservation of Albatrosses and Petrels (ACAP)

[50] https://www.ccamlr.org/en/system/files/e-pt6_1.pdf

- The Antarctic Treaty Consultative Meeting (ATCM)
- The Food and Agriculture Organization of the United Nations (FAO) COFI
- The Commission for the Conservation of Southern Bluefin Tuna (CCSBT)
- The Inter-American Tropical Tuna Commission (IATTC)
- The International Commission for the Conservation of Atlantic Tunas (ICCAT)
- The Indian Ocean Tuna Commission (IOTC)
- The World Conservation Union (IUCN)
- The International Whaling Commission (IWC)
- The Northwest Atlantic Fisheries Organization (NAFO)
- The North East Atlantic Fisheries Commission (NEAFC)
- The South East Atlantic Fisheries Organisation (SEAFO)
- The Southern Indian Ocean Fisheries Agreement (SIOFA)
- The South Pacific Regional Fisheries Management Organisation (SPRFMO)
- The United Nations Environment Programme (UNEP)
- The Commission for the Conservation and Management of the Highly Migratory Fish Stocks of the Western and Central Pacific Ocean (WCPFC)

In turn there are a number or organisations that attend the CCAMLR annual meetings as observers, these include ACAP, CCSBT, CEP, SCAR, SEAFO, ARK, ASOC, ATS, COLTO and Oceanites.

There are three main fisheries that operate in the Convention Area, bottom longlining for two species of toothfish (*Dissostichus eleginoides, Dissostichus mawsoni*) and midwater trawling for icefish (*Champsocephalus gunnari*) and Antarctic krill (*Euphausia superba*). Reporting requirements for these fisheries are outlined in the Conservation Measures (CM 23-01, 23-02, 23-03, 23-04, 23-05, 23-06 and 23-07). Vessels must use logbooks developed in Excel by CCAMLR[51] which record data on a haul by haul basis. In the case of bottom fisheries (longline) vessels must also record the number of VME species they encounter on every haul. Catch, effort and VME data are summarised and submitted on a five-day basis to the Secretariat, these reports are used to monitor the total catches in an area against the quota allocated to it and predict when the fishery will close. Fine scale (haul by haul data) are also submitted on a monthly basis via the vessel's flag state.

VME indicator species data are defined in the CCAMLR VME Taxa Classification Guide[52] and vessels are required to report on all VME species recovered according to the protocols set out under CM 22-07. This applies to vessels bottom fishing in areas:

> "*…in the Convention Area south of 60°S, and to the rest of the Convention Area with the exception of subareas and divisions where an established fishery was in place in 2006/07 with a catch limit greater than zero.* "

It also applies to the areas in Division 58.4.1 north of 60°S[53]. This Conservation Measure was first adopted by the Commission in 2007, at CCAMLR XXVII and came into force the following season (2008/09). The recording of VMEs is part of CCAMLR's management strategy and the collection and reporting of VME-indicator data is a Flag State responsibility. Vessels are required to collect the data and report these data to the CCAMLR Secretariat, either directly when authorised to do so by the Flag State, or via the Flag State itself. To quantify the VME data, vessels divide their lines, either into a section that has 1,000 hooks or is 1,200 meters long, whichever is the shortest.

[51] https://www.ccamlr.org/en/data/ccamlr-data-forms

[52] https://www.ccamlr.org/en/document/publications/vme-taxa-classification-guide

[53] https://www.ccamlr.org/en/measure-22-07-2013

For each section the VME indicator species are placed into buckets (10 litre containers), if five or more indicator units (i.e. organisms) are recovered within one segment, a vessel is required to immediately notify the Secretariat by submitting a 'VME-Indicator Notification', of the midpoint of the segment and the quantity of the VME units recovered. A VME unit is defined as below:

a) Volume (litre) for VME-indicator organisms which fit into a 10-litre container;

b) Weight (kg) for VME-indicator organisms which do not fit into a 10-litre container (e.g. branching species); and

VME-indicator units are the combined total volume of VME-indicator organisms which fit into a 10-litre container and weight of VME-indicator organisms which do not fit into a 10-litre container (i.e. unit = volume + weight).

Where the number of VME indicator units notified is equal to or greater than 10, the area will be designated as a 'Risk Area'. A Risk Area has a radius of 1 nautical mile from the mid-point of the line segment from which the notified VME-indicator units were recovered (Fig. A1.1.2). On encountering a Risk Area Members shall require their vessels to complete hauling any lines intersecting with the risk are without delay and not to set any further lines intersecting with the Risk Area.

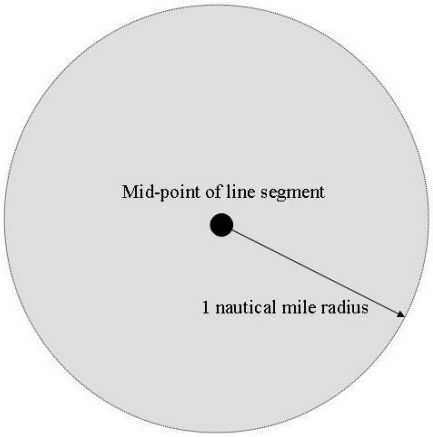

Figure A1.1.2 – A Risk Area has a radius of 1 nautical mile from the mid-point of the line segment[54].

On receipt of a VME-indicator notification where the quantity of VME-indicator units notified is greater than or equal to 10, the Secretariat will, within one working day, notify all Members and vessels involved in that fishery of the location of the Risk Area.

Risk Areas remain closed to fishing (i.e. vessels are not permitted to set longlines or pots in Risk Areas) until they have been reviewed by the Scientific Committee and subsequent management actions are determined by the Commission.

On receipt of 5 VME-indicator notifications from within a single fine-scale rectangle the Secretariat will, within one working day, notify all Members and vessels involved in that fishery of the location of that fine-scale rectangle (0.5° latitude by 1.0° longitude) and vessels must cease fishing in in this area.

[54] Taken from VME-Indicator-v2014c-data-form - https://www.ccamlr.org/en/node/75847

Table A1.1.3 – Timeline and VME data reporting requirements. * submission deadlines: 5-day catch and effort reports (CM 23-01); 10-day catch and effort reports (CM 23-02); fine-scale catch and effort data (CM 23-04).

Timeline/Event	Data Requirement	Data Form and Submission Deadline
On hauling every line segment		
to the extent possible	Record the mid-point of the line segment and the quantity of VME-indicator organisms recovered, including zero catches	Use form VME and submit data form with the fine-scale catch and effort data
If 5 or more VME-indicator units are recovered (VME-indicator notification)	Record the mid-point of the line segment and the quantity of VME-indicator organisms recovered	Use form VME and immediately notify the CCAMLR Secretariat
On completion of hauling entire line	Report the total quantity of VME-indicator organisms recovered from the longline or pot line	Use form C2 (longline)*, or C5 (pot)*
At the end of each 5-day reporting period (toothfish fisheries) or 10-day reporting period (crab fisheries)	Report the total quantity of VME-indicator organisms recovered during the reporting period	Use form TAC*

VME data is stored by the Secretariat, existing VMEs are outlined in CM 22-09 and can be publicly accessed through CCAMLR's online GIS feature[55].

CCAMLR implements a Vessel Monitoring System (VMS) to monitor the location and activities of fishing vessels that operate inside the Convention Area. Fishing vessels provide VMS data to the Secretariat in relation to entry and exit from the Convention Area and movement between subareas and divisions within the Convention Area. VMS data is also utilised for surveillance activities undertaken by Members inside the Convention Area and for the verification of information provided through the Catch Documentation Scheme (CDS) through which all toothfish catches are recorded.

All vessels authorised by Members to fish in the Convention Area are required to report VMS data to their Flag State which must then forward this data to the CCAMLR Secretariat. Many vessels also report VMS data directly to the CCAMLR Secretariat in near real-time.

The requirements for the vessels VMS system are outlined in CM10-04. It states that vessels operating inside the Convention Area must have a vessel monitoring device reporting at least every hour to its Flag State. For vessels operating in new and exploratory fisheries in the Convention Area, VMS data must be provided to the CCAMLR Secretariat every hour. For all other fisheries, VMS data must be sent to the CCAMLR Secretariat within 10 days of the vessel departing the Convention Area

CCAMLR has adopted conservation measures to specifically address the threat of IUU fishing including the establishment of the Contracting Party IUU Vessel List (Conservation Measure 10-06) and the Non-Contracting Party IUU Vessel List (Conservation Measure 10-07) and the control of nationals (Conservation Measure 10-08).

[55] https://www.ccamlr.org/en/data/online-gis

CCAMLR annually reviews available information, including Member sighting reports, on IUU fishing activities and has established the Contracting Party IUU Vessel List[56] (there are currently no vessels on this list) and the Non-Contracting Party IUU Vessel List[57] (currently 17 vessels). These lists are made available to the Members, non-Contracting Parties, other inter-governmental organisations, non-governmental organisations and the public and are updated regularly as new information is provided by Members and non-Contracting Parties.

Most meeting reports are publicly available (unless a Member State explicitly requests a particular report be restricted) and are published annually after each meeting. Catch and effort data are available to download and are updated annually[58].

A1.1.2. Fishing activities controlled by the organisation

Bottom fishing within the Convention Area is prohibited, by CM 22-08, in areas shallower than 550 meters and operationally the maximum depth lines are set at is around 2,000 meters. For most calculations the fishable depth range is taken as between 600 and 1,800 meters (CCAMLR Secretariat, 2015). Given the limitations due to sea ice the total fishable area, for bottom fishing, within the Convention Area is less than 1%.

Bottom fishing in the Convention Area is undertaken primarily using bottom set longlines. Pots can also be used but have not been since 2008. Although bottom trawling is prohibited under 22-05, there are exempt areas within the Heard and MacDonald Islands (directly managed by Australia) where it is undertaken by two vessels.

Bottom fishing targets toothfish species, Patagonian toothfish (*Dissostichus eleginoides*, FAO code: TOP) and Antarctic toothfish (*Dissostichus mawsoni,* TOA). Common bycatch species include grenadier (Macrouridae spp. GRV) and skate (Rajiformes spp. SRX). Blue antimora (*Antimora rostrata,* ANT) and moray cods (*Muraenolepis* spp. MRL).

There are 15 stocks of toothfish fished (both species). Stocks are formally assessed quantitatively by WG-FSA every two years and advice on the total allowable catch passed onto the Scientific Committee where it is reviewed and passed onto the Commission where the catch limits are set and embedded into the relevant Conservation Measure. Assessments and catch limits for *Dissostichus* spp. can be found in individual fishery reports[59] and are summarised, for the 2018/19 season, in SC-CAMLR-XXXVI, Table A1.1.

An assessment of grenadier bycatch was undertaken for Subarea 88.1 in 2008, but no assessments on bycatch species have been done since then.

Management strategies are in place to reduce bycatch and evaluate the impact of fishing gear on common bycatch species, including VME indicator species, within the Convention Area. These include:

- Prohibiting finfish fishing around the Antarctic Peninsula and the South Orkney Islands (apart from research fishing with pots) to protect finfish stocks depleted prior to the establishment of CCAMLR;
- Prohibiting bottom trawling in all high-seas areas to protect benthic communities;
- Prohibiting the use of gillnets in all areas, also to protect benthic communities; and,
- Prohibiting bottom fishing, with pots and longlines, in water shallower than 550 m around the entire Antarctic continent to protect shelf-based benthic systems.

[56] https://www.ccamlr.org/en/compliance/contracting-party-iuu-vessel-list
[57] https://www.ccamlr.org/en/compliance/non-contracting-party-iuu-vessel-list
[58] https://www.ccamlr.org/en/node/74766
[59] https://www.ccamlr.org/en/publications/fishery-reports

The only current CCAMLR high-seas fisheries are pelagic trawling for krill, demersal longlines, and pots for crabs and finfish.

With regards to the evaluation of impacts of bottom fishing gear, all vessels participating in the fishery are required to undertake an assessment of their gear under CM 22-07 (2013) (Interim measure for bottom fishing activities subject to Conservation Measure 22-06 encountering potential vulnerable marine ecosystems in the Convention Area) to calculate the total footprint and impact the gear may have. These can be found in the CCAMLR list of authorised vessels[60], along with the notifications from individual vessels. The proportion of the Convention Area impacted by bottom fishing can be considered to be less than 1%.

There are 36 longline vessels from 13 different countries that have formal notification to fish in the Convention Area for the 2018/19 season. The vessels range in size from around 50 meters up to around 70 meters and all use longline gear, either conventional Spanish or integrated weight system or, more recently, vertical trotlines. Longlines vary in length from relatively short lines of 3,000 meters up to longer ones over 15,000 meters.

The Convention Area is divided in a different Areas, Subareas and Divisions (ASDs), (Fig. A1.1.1), fishing effort from longline vessels targeting toothfish since 2010/11 up to 2015/16 (Table 2.1.4).

Table A1.1.3 Effort (in days) by area and sub-division (ASD) in the Convention Area 2009/10 – 2015/16 (source: CCAMLR Statistical Bulletin)

ASD	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
48.2						25	22
48.3	865	544	573	595	582	501	518
48.4	63	46	46	49	25	28	38
48.5				5	10		
48.6	149	101	121	175	67	83	150
58.4.1	62	98	45	22	27	36	111
58.4.2	26	9	30	11		2	
58.4.3a		5	20	19	31	23	
58.4.3b	12	12	12				
58.4.4a	5						
58.4.4b	42	32	34	29	44	44	37
58.5.1	990	953	914	928	876	748	878
58.5.2	341	390	368	464	425	755	657
58.6	297	193	231	197	239	306	440
58.7	82	76	135	136	196	209	156
88.1	520	387	436	597	501	460	403
88.2	79	188	149	106	89	166	136

Catches of the target species are limited by a total allowable catch and so have been fairly consistent (Table A1.1.5). The main bycatch species are also subject to catch limitations and will never rise above a proportion of the target species catch, although catches have increased in recent years (Table A1.1.6).

Table A1.1.4 – Catches of target species within the Convention Area 2010/11 – 2015/16 (source: CCAMLR Statistical Bulletin).

Species	2010/11	2011/12	2012/13	2013/14	2015/16
D. eleginoides	10 483	11 265	11 767	12 057	11 910

[60] https://www.ccamlr.org/en/compliance/list-authorised-vessels

D. mawsoni	4 216	4 064	3 845	3 835	4 136

Table A1.1.5 – Catches of main bycatch species within the Convention Area 2010/11 – 2015/16 (source: CCAMLR Statistical Bulletin).

Species	2010/11	2011/12	2012/13	2013/14	2015/16
Antimora	70	106	141	185	228
Macrourus spp	337	402	1265	1 200	1 100
Rajiformes	12	21	20	29	50

The main markets for toothfish are Japan and the USA (where it is marketed as Chilean sea bass) with small amounts going to other markets such as the UK and Norway. The price of toothfish has risen in recent years and while there are no records of the overall value of the fishery the price at first sale reached a peak of $34 per kilo in 2016, it is now at around $30 per kilo. Taking the total catch from the 2015/16 season the overall value to the fishing industry is estimated at USD $480,000,000 per annum.

A1.1.3. Description of Sensitive Species and Habitats

Compared to many global ocean areas where bottom fishing occurs, the Southern Ocean is characterised by extremely limited data on both the prevailing bottom topography and associated benthic marine ecosystems (Reid, 2011). While there is an increasing amount of research into benthic fauna in the Southern Ocean, particularly with regards the development and establishment of a number of MPAs in the Convention Area, the majority of the benthic data to date has been obtained opportunistically from bottom longline fishing vessels. Fisheries-independent observations available (for the Ross Sea) have been biased towards waters shallower than where the fisheries occur (Parker and Smith, 2011). Few data are available describing the distribution of VME indicator taxa in the Ross Sea region outside the spatial footprint of the fishery (Parker and Smith, 2011). Data available from fishing vessels include both the data reported by the vessel itself, which is restricted to number of units of VME indicator species observed, and data recorded by observers. Observer data is more detailed and is described at the lowest taxonomic level possible for each indicator species.

Other data that are available are collected from research surveys, much of this has been collated and used for the scientific justification for the creation, or proposed creation, of a network of MPAs in the Convention Area. Summaries of the data available can be found in various reports to the Scientific Committee, for example the Ross Sea (SC-CAMLR-XXXIII/BG/23 Rev.1), The Weddell Sea (SC-CAMLR-XXXV/BG/12), East Antarctica (SC-CAMLR-XXXIII/BG/38) and the Antarctic Peninsula (SC-CCAMLR-XXXVI/17). A number of VMEs have been identified and designated through trawl surveys (WG-EMM-12/51, WG-EMM-09/32), all in Subareas 48.1 and 48.2 around the Antarctic peninsula (Fig. A1.1.4). In addition, the distribution of some of the VME taxa has been estimated using ecological models incorporating biological and environmental data.

Few, if any, of the listed indicator species on the CCAMLR VME Indicator guide (Table A1.1.6) have been subject to an IUCN assessment and none are currently on the Red List.

Table A1.1.6 VME Indicator taxa as used by CCAMLR.

Phylum	Level	FAO Code	Taxon/common name examples
Cnidaria (CNI)	Gorgonacea (Order)	GGW	Isididae (Bamboo)
			Coralliidae (Red / precious)

			Primnoidae (Bottle brush, sea fans)
			Paragorgiidae (Bubblegum)
			Chrysogorgiidae (Golden)
	Anthoathecatae (Order)	AZN	Hydroidolina (sub class) Hydroids
	Stylasteridae (Family)	AXT	Stylasterids (Hydrocorals)
	Scleractinia (Order)	CSS	Stony corals
	Antipatharia (Order)	AQZ	Black corals
	Zoantharia (Order)	ZOT	Zoanthids
	Actiniaria (Order)	ATX	Anemones
	Alcyonacea (Order)	AJZ	Soft Corals
	Pennatulacea (Order)	NTW	Sea pens
Porifera (PFR)	Hexactinellida (Class)	HXY	Glass sponges
	Demospongiae (Class)	DMO	Siliceous sponges
Chordata (CZR)	Ascidiacea (Class)	SSX	Sea squirts
Bryozoan	Byrozoans (Phylum)	BZN	Lace corals
Chemosynthetic	Various Groups	CXV	Chemosynthetic communities
Brachiopoda	Brachiopoda (Phylum)	BRQ	Lamp shells
Hemichordata	Pterobranchia (Class)	PBQ	Acorn worms
Annelida	Serpulidae (Family)	SZS	Serpulid tube worms
Xenophyophora	Xenophyophora (Phylum)	XEF	Xenophyophores
Arthropoda	Bathylasmatidae (Family)	BWY	Goose and acorn barnacles
Mollusca	Adamussium colbecki (Species)	DMK	Antarctic scallop
Echinodermata (ECH)	Stalked crinoid (Order)	CWD	Stalked crinoids (sea lilies)
	Euryalida (Order)	OEQ	Basket and snake stars
	Cidaroida	CVD	Pencil and spine urchins

CCAMLR has defined VMEs in its area of authority as; *"Benthic ecosystems containing species or communities that are considered at risk of disturbance due to fishing or other human activities. The most vulnerable ecosystems are those that are both easily disturbed and very slow to recover, or may never recover. These include ecosystems associated with seamounts, hydrothermal vents, deep-sea trenches and submarine canyons, as well as oceanic ridges."*

A shorter version is given under CM22-06 as; *"… the term 'vulnerable marine ecosystems' in the context of CCAMLR includes seamounts, hydrothermal vents, cold water corals and sponge fields."*

The above definitions are not as comprehensive as the FAO definition, but are designed to include certain VME types as defined by habitat features that were not specifically mentioned in the FAO definition.

Potential VME areas at risk of bottom fishing impacts are designated through a process of observer-based recording of VME indicator species as bycatch. VMEs can also be designated during fishery independent trawl surveys if a trigger level of VME taxa is reached. The selection of VME taxa has been criteria based, but mainly due to the fact they create a fragile biogenic structure that may serve as a habitat for other organisms (e.g. sponges, all anthozoan and hydrocorals). Hydroids, bryozoans and sea squirts are also included because of their biogenic structure forming properties through the formation of dense turfs or mats that create unique habitats for other organisms. Stalked crinoids and basket stars are also included as indicators of areas containing vulnerable communities. Furthermore, chemosynthetic taxa are also included because of their rarity, and high likelihood of increased local-scale endemism (CCAMLR-XXVII/19).

The depth ranges of the VMEs and risk areas identified depend on whether they are designated through fishery independent surveys or from fishery by-catch records. The VME in Subareas 48.1 and 48.2, have been identified through survey trawls and range in depth between 42 and 695 meters, whereas the VMEs in Subareas 88.1 and 88.2, were identified through fishing by-catch records and between 715 to 1882 meters.

A1.1.4. Assessment of impacts upon sensitive species and habitats

CM 91-04 outlines the general framework for the establishment of CCAMLR Marine Protected Areas (MPAs). This includes the requirement, under paragraph 2, that MPAs are set up on the basis of the best available scientific evidence to achieve a number of objectives, including monitoring of benthic habitats, as outlined below:

i) the protection of representative examples of marine ecosystems, biodiversity, and habitats at an appropriate scale to maintain their viability and integrity in the long term;

ii) the protection of key ecosystem processes, habitats, and species, including populations and life-history stages;

iii) the establishment of scientific reference areas for monitoring natural variability and long-term change or for monitoring the effects of harvesting and other human activities on Antarctic marine living resources and on the ecosystems of which they form part;

iv) the protection of areas vulnerable to impact by human activities, including unique, rare or highly biodiverse habitats and features;

v) the protection of features critical to the function of local ecosystems; and,

vi) the protection of areas to maintain resilience or the ability to adapt to the effects of climate change.

Paragraph 5(v) requires Members undertaking research in the area to compile a report on their research which can then be reviewed by the Scientific Committee. This has so far been undertaken for the South Orkney Islands MPA, established in 2009, and a summary report was produced in 2014 (SC-CAMLR-XXXIII/BG/19). A similar report is in preparation based upon expected research in the Ross Sea MPA, designated under CM 91-05.

Other reports from surveys are submitted, reviewed and assessed by WG-EMM and WG-FSA and are made available on the CCAMLR website under the relevant meeting documents. Research plans that include research on VMEs must also be submitted to CCAMLR under CM 24-01.

All longline vessels operating in the Convention Area are required to carry at least one scientific observer, those operating in exploratory fisheries (where VME taxa are recorded and reported to CCAMLR) are required to carry two observers. Observers independently monitor the benthic bycatch and record any VME species, although no comprehensive assessment has been conducted on these data to date.

No significant adverse impacts have been identified by CCAMLR, in part, due to the footprint of the longline fishery being assessed as very small. No new conservation measures (CMs) have been established as a result of current assessments.

A1.1.5. Mapping of sensitive species and habitats

Surveys are organised and funded through Member States wishing to undertake studies in CCAMLR's Regulatory Area. Prior to conducting research, a Member State must notify CCAMLR of its research plan under CM 24-01, the plan is reviewed by WG-FSA, and the Scientific Committee and will either be approved or rejected by the Commission based on the advice of the Scientific Committee. All scientific data collected are available to all CPs.

Scientific observers are present on all longline fishing vessels and collect data on VMEs indicator species, which are submitted to the Secretariat. The logistical and payment arrangements for the observer will vary between Member States and vessels, but in general observers must be officially designated by their Flag State and observers must be of a different nationality to the nationality of the

flag state of the vessel they are observing on. All data are collected according to standard operating procedures, checked and stored by the Secretariat to improve quality.

The extent of VMEs, VME risk areas and VME fine scale rectangles represents a small proportion of the total Regulatory Area (<1%) and will only represent where the bottom fisheries or surveys overlap with the VME habitats. Although habitat suitability models have been used to estimate distribution, the results from such models are not readily available.

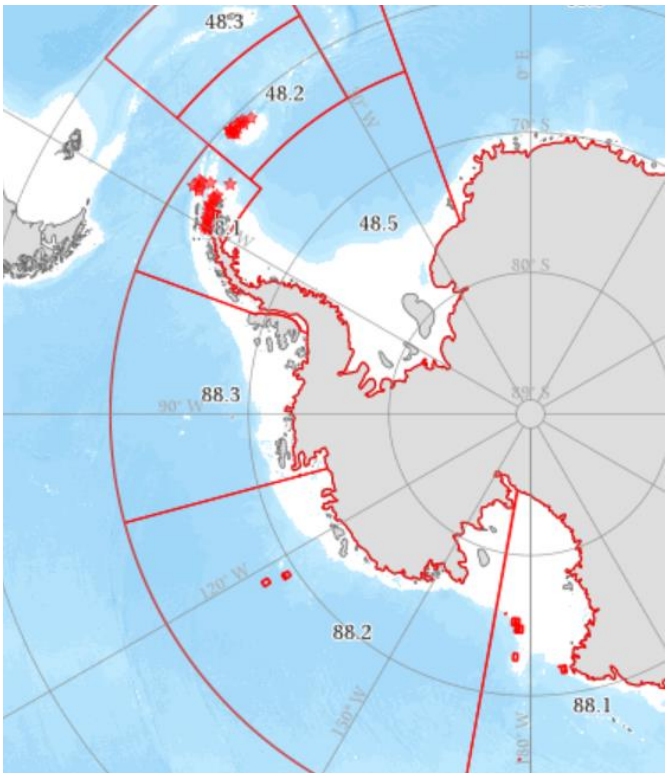

Figure A1.1.3 – Map of Convention Area showing VMEs in Subareas 48.1 and 48.2 and VME risk areas and VME fine scale rectangles in Subareas 88.1 and 88.2 (source: CCAMLR online GIS).

A1.1.6. Impact mitigation and protection

The Convention Area is 35,716,100 km^2 and is divided into a number of FAO Areas, Subareas and Divisions (Fig. A1.1.1). There are no changes being considered for the overall extent of the Convention Area, although there will be changes in the spatial management of fisheries with the introduction of new MPAs. There have also been changes to some of the small scale research units in some Subareas in the past related to toothfish stock assessments, most notably in Subarea 88.2 in 2011 (SC-CCAMLR-XXX, Annex 7, paragraph 6.127).

The encounter protocols for VME indicator species (described above) has resulted in identification of VME risk areas which are then subject to a fishery closure. Accordingly, there is no overlap between known VME areas and fishing activity. Other known areas where VMEs are protected from bottom fishing activity through the designation of MPAs, include the South Orkney MPA and areas shallower than 550 meters.

Should a vessel recover 5 or more VME indicator units (as defined in Table A1.1.6) during a section of the haul, the vessel must notify CCAMLR. The area at the mid-point of the line section will then be defined as a risk area under CM 22-07. Between January 2009 and December 2015, a total of 76 risk areas had been notified to CCAMLR and closed to bottom fishing, nothing has been notified since 2015 according to the VME Registry.

The whole of the Convention Area has been closed off to bottom trawling for commercial purposes, apart from the fishery around Heard and MacDonald Island where two vessels trawl for toothfish.

All exploratory fisheries must notify to CCAMLR under CM 21-02 and must include a research plan containing the following information:

a) the nature of the exploratory fishery, including target species, methods of fishing, proposed region and maximum catch levels proposed for the forthcoming season;

b) specification and full description of the types of fishing gear to be used;

c) biological information on the target species from comprehensive research/survey cruises, such as distribution, abundance, demographic data and information on stock identity;

d) details of dependent and related species and the likelihood of their being affected by the proposed fishery;

e) information from other fisheries in the region or similar fisheries elsewhere that may assist in the evaluation of potential yield;

f) if the proposed fishery will be undertaken using bottom trawl gear, information on the known and anticipated impacts of this gear on vulnerable marine ecosystems, including benthos and benthic communities.

Item (f) only applies to vessels new to the fishery, or established vessels that have altered their fishing gear. The assessment that must be completed is under CM 22-06, Annex A and requires WG-FSA and the Scientific Committee to assess the scope of the activity, the proposed gear types to be employed and any mitigation methods used to reduce SAI upon VMEs.

A1.1.7. Monitoring of VME impacts

There is no specific monitoring of VMEs once they have been designated, although scientific surveys are undertaken in areas considered to have high diversity, such as the surveys undertaken by the American AMLR programme in the South Orkney MPA. Surveys are undertaken using trawls and funded by the Member States. Identification guides have been developed for use by observers, scientists, and vessels crews. Specifically, for VME taxa there is the VME taxa classification guide[61], or, specific to Heard and Macdonald Islands there is more comprehensive guide that contains a much wider range of species[62].

[61] https://www.ccamlr.org/en/document/publications/vme-taxa-classification-guide
[62] https://www.ccamlr.org/en/document/science/field-identification-guide-heard-island-and-mcdonald-island-benthic-invertebrates

A1.2. CECAF

A1.2.1. Organisation, Data and Governance

The Fishery Committee for the Eastern Central Atlantic (CECAF) is the Regional Fishery Body in charge of promoting sustainable utilization of the living marine resources within its area of competence, by the proper management and development of the fisheries and fishing operations. The area of competence of CECAF corresponds to a large extent to the statistical area 34 of FAO, being defined as:

"*all the waters of the Atlantic bounded by a line drawn as follows: from a point on the high water mark on the African coast at Cape Spartel (lat. 35°47'N, long. 5°55'W) following the high water mark along the African coast to a point at Ponta de Moita Seca (lat. 6°07'S, long. 12°16'E) along a rhumb line in a north-westerly direction to a point on 6° south latitude and 12° east longitude, thence due west along 6° south latitude to 20° west longitude, thence due north to the Equator, thence due west to 30° west longitude, thence due north to 5° north longitude, thence due west to 40° west longitude, thence due north to 36° north longitude, thence due east to 6° west longitude, thence along a rhumb line in a south-easterly direction to the original point a Cape Spartel*"[63].

This comprises both the exclusive economic zones (EEZs) of Coastal States and areas beyond national jurisdictions (ABNJ). CECAF covers all living marine resources within its area of competence, as well as the fisheries targeting them (Fig. A1.2.1).

CECAF was established in 1967, by Resolution 1/48 adopted by the FAO Council at its Forty-Eighth Session held in Rome under Article VI (2) of the FAO Constitution. Its statutes, particularly the description of the purpose, functions and responsibilities of the Committee, were last amended in October 2003. The functions and responsibilities of CECAF are the following:

a) To keep under review the state of resources within its area of competence and of the associated industries;
b) To promote, encourage and coordinate research in the area related to living resources and to draw up programmes required for this purpose and to carry out such research as appropriate;
c) To promote the collection, exchange, dissemination and analysis or study of statistical, biological, environmental and socio-economic data and other marine fisheries information;
d) To establish the scientific basis for regulatory measures leading to the conservation and management of marine fishery resources, to formulate such measures through subsidiary bodies, as required, to make appropriate recommendations for the adoption and implementation of these measures and to provide guidelines/advice for the adoption of regulatory measures by Member Governments, sub-regional or regional organizations, as appropriate;
e) To provide advice on monitoring control and surveillance, especially as regards issues of a sub-regional and regional nature;
f) To encourage, recommend and coordinate training in the priority areas of the Committee;
g) To promote and encourage the use of the most appropriate fishing craft, gear and techniques;
h) To promote liaison among and with competent institutions within the (maritime zone) of the Committee and to propose and keep under review working arrangements with other international organisations which have similar objectives within that area.

Unlike other FAO consultative bodies created under Article XIV, CECAF cannot adopt binding regulatory measures concerning fisheries management. Instead, CECAF role is:

i. to establish the scientific basis for the elaboration of regulatory measures;

[63] http://www.fao.org/fishery/rfb/cecaf/en

ii. to make recommendations for their adoption and implementation and
iii. to provide advice for adoption of regulatory measures by member governments, regional and/or sub-regional organisations (CECAF, 2016a).

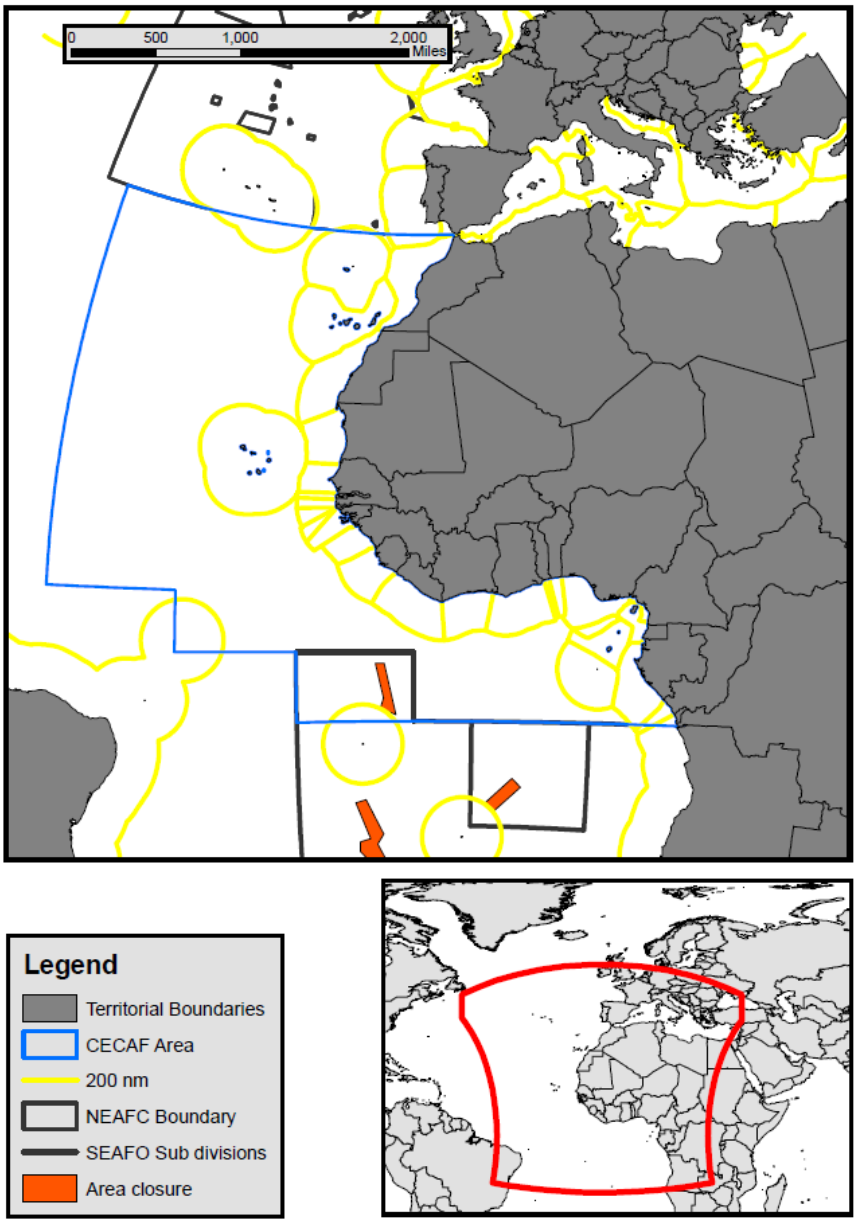

Figure A1.2.1 – CECAF area (FAO major fishing area 34). Area closure in CECAF-SEAFO overlap designated by SEAFO. Sub-divisions available in CECAF report[64]. Red area on bottom-right panel indicates extent of top panel.

CECAF is composed of Member Nations and Associate Members of the Organization, selected from those African nations whose territory borders the Atlantic Ocean, from Morocco to Angola, and other nations fishing or carrying out marine research in the area or having some other interest in the fisheries and thereof, whose contribution to the work of CECAF is considered essential. CECAF presently has 34 members, including[65]:

[64] http://www.fao.org/fishery/area/Area34/en
[65] http://www.fao.org/fishery/area/Area34/en

a) 22 coastal States: Angola, Benin, Cameroon, Cabo Verde, Congo, Congo Democratic Republic, Côte d'Ivoire, Equatorial Guinea, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mauritania, Morocco, Nigeria, Sao Tomé e Principe, Senegal, Sierra Leone, Spain and Togo.
b) 11 non-coastal States: France, Cuba, Greece, Italy, Japan, Republic of Korea, The Netherlands, Norway, Poland, Romania and the United States of America.
c) 1 regional economic integration organization: the European Union.

The current simplified structure of CECAF, consisting of a Committee and Scientific Sub-committee (SSC), was agreed in 1998. The Committee is the central body and it is composed of all CECAF member States. The main function of the SSC is to provide appropriate advice to the Committee for fisheries management decisions.

As an FAO statutory body, CECAF is part of FAO and is therefore dependent on the FAO for its work. The work of the Committee and of the SSC is supported by the Secretariat, which is comprised of the Executive Secretary, helped by one staff member. It is housed in the FAO Regional Office for Africa, in Accra, Ghana. The Executive Secretary, as part of the FAO staff, does have several other attributions besides those related to CECAF. The FAO Fisheries and Aquaculture Department also provides services to CECAF (CECAF, 2012).

The Committee, in line with its mandate, reviews activities of relevance to the sustainable use of resources, including artisanal fisheries, and it formulates and recommends specific management actions or research recommendations to be implemented by its members. The Committee is scheduled to meet every two years. The main function of the SSC is to study the stocks, to assess their status and, on the basis of the results achieved, to provide fisheries management advice to the Committee (CECAF, 2016a). The SSC met for the first time in the year 2000 and proposed to establish three Working Groups (WGs):

a) Working Group for assessment of small resources
b) Working groups for the assessment of demersal resources
c) Working Group for artisanal fisheries.

For practical reasons, the WGs for small pelagics and for demersal species were later subdivided into two sub-groups each:

i) the northern sub-group, covering the area from Morocco to the southern border of Senegal
ii) the southern sub-group, covering the area from Guinea-Bissau to Angola, and including the island States.

The SSC is also scheduled to meet every two years, alternating with the Committee meetings. However, the two last sessions of both the SSC and the Committee have taken place at four years intervals. This delay has been largely due to financial and human resources issues (CECAF, 2016b).

Regarding the WGs, only the WG on the Assessment of Small Pelagics meets regularly, once a year since 2001. In recent years, members have supported the participation of their respective scientists. The other WGs meet every two or three years, but they depend on support from external donors or availability of additional funding within FAO. The WG on Artisanal Fisheries has not met since 2007, although following the decision of the last SSC meeting in 2015, it is to be re-activated.

Since 1998, the SSC has been responsible for providing scientific advice to support fisheries management decisions, which are provided to the Committee for validation and transmission to Member States. The four scientific assessment WGs analyse the available data to assess the status of demersal and small pelagic resources and make fisheries management recommendations. The WGs also make recommendations on scientific research, data collection, analysis methods and training requirements. All the work undertaken and conclusions of the WGs are compiled in scientific reports which are presented and discussed at the SSC for validation (CECAF, 2016a).

All CECAF members are obliged to provide information on catch and fishing effort by species and statistical divisions, including fleet size and vessel characteristics, for both artisanal and industrial sectors. Data from industrial fleets are obtained both from logbooks and from landings at port. Several CECAF members, however, lack the logistics to routinely collect statistical data on the fisheries and species caught, particularly in the case of the subsistence and artisanal fisheries sectors (CECAF, 2012). There is notable disparity in terms of capacity and infrastructure available to CPs for data collection and analysis. The WGs use several types of data for their work (CECAF, 2016a):

i. national statistics which are transmitted to the different WGs by member countries through their experts and which include data on catch and effort disaggregated by species, fishing area and fishing fleets;
ii. databases for FAO catch statistics programme Fishstat+/ CECAF database;
iii. data obtained from national exploratory and research surveys at sea;
iv. data derived from research surveys at sea at regional level (for example, R/V *Dr Fridtjof Nansen*);
v. information on biological parameters;
vi. information on environmental parameters and;
vii. data or studies derived from specific reports or relevant projects.

The WGs report their conclusions and recommendations to the SSC, which validates them. Failure of the SSC to meet delays the validation process, but CPs can still use provisional reports to formulate management measures. There are four other regional fisheries bodies whose competence overlaps with CECAF:

i. the Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic Ocean (ATLAFCO)
ii. the Sub-Regional Fisheries Commission (SRFC)
iii. the Fishery Committee for the West Central Gulf of Guinea (FCWC), and
iv. the Regional Fisheries Commission for the Gulf of Guinea (COREP).

Their objectives are in general, similar, consisting basically in policy harmonization and promotion and strengthening of the regional or sub-regional cooperation in fisheries management and development. The main difference relates to the technical work, including data gathering and stock assessment, which to a large extent are still being carried out only by CECAF (CECAF, 2012).

VME data are not currently collected by CECAF directly, although some information is available through different projects or initiatives developed in the region. The first FAO/ CECAF Technical Workshop on Deep-sea fisheries and Vulnerable Marine Ecosystems in the Eastern Central Atlantic took place in 2016 (FAO, 2017), to support the implementation of the FAO Deep-sea Fisheries Guidelines in the Eastern Central Atlantic Ocean by CECAF, and to increase knowledge and share experiences to address potential impacts of deep-sea bottom contact fisheries on VMEs. One of the main objectives of this workshop was to discuss information relevant to the identification and protection of VMEs. Some proposed work was recommended conforming to FAO best practice and the efforts of other RFMOs (e.g.: NAFO and SEAFO) but CECAF has no regulatory powers and therefore it is unable to establish any spatial management measures. Among other recommendations, it was suggested to develop mechanisms (and/or a database) for storing or compiling information from databases relevant to deep-sea fisheries and VMEs from commercial and research vessels in the CECAF area and to investigate the possibility of using VMS information available from commercial vessels fishing in the CECAF area to map and monitor deep-sea fisheries in respect to possible VME areas.

A1.2.2. Fishing activities controlled by the organisation

At present, CECAF capture database includes catch statistics for 297 species items, 64% of them at species level (FAO, 2016a). A total of 77 types of fisheries, with 197 records of marine resources have been reported for CECAF so far in the FAO Fisheries and Resources Monitoring Systems (FIRMS)[66], which still needs to be completed and updated. This includes a great variety of fisheries including artisanal and industrial fisheries from Coastal States and mainly industrial fisheries from Distant Water Fishing Nations (DWFN). Although the number of fisheries and resources might be even higher, descriptions of many fishing fleets and gear types can be found in the FIRMS website.

The bottom contacting fisheries in CECAF are carried out at variable depths, ranging from coastal waters to depths of around 800-900 m, the maximum depth where certain industrial demersal trawlers operate. However, catches of this deep-water fishery represent a small proportion of the whole fishery area.

There are currently about 96 species/stocks being assessed and monitored to some degree, by CECAF[15]. For evaluation purposes, CECAF differentiates a northern and a southern area, including the followings stocks: 7 small pelagics/north, 16 small pelagics/south, 27 demersals/north and 46 demersals/south. About two thirds of these stocks are shared by two or more countries (CECAF, 2012), (Table A1.2.1).

Table A1.2.1[67] – Species and stocks assessed by CECAF. * Key stocks specifically designed to this report from the information compiled from the last CECAF SSC (FAO 2016). N: North (from Morocco to Senegal); S: South (from Guinea Bissau to Angola); 1N: Morocco + Mauritania + Senegal + The Gambia; 2N: Mauritania + Senegal + The Gambia; 3N: Senegal + The Gambia; 1S: G. Bissau + Guinea; 2S: G. Bissau + Guinea + Sierra Leone + Liberia; 3S: G. Bissau + Guinea + Liberia; 4S: Ivory Coast + Ghana + Togo + Benin; 5S: Nigeria + Cameroon; 6S: Nigeria + Cameroon+ S. Tome + Equatorial Guinea; 7S: Gabon + Congo; 8S: Gabon + Congo + DR Congo; 9S: Gabon + Congo + DR Congo + Angola; 10S: Gabon + DR Congo + Angola; 11S: Congo + Gabon + Angola; 12S: S. Tome + Equatorial Guinea; 13S: Congo + Angola

Species	FAO Code	Stock*	Typical Assessment Interval (years)
Sardine (*Sardina pilchardus*)	PIL	Zone A+B, Zone C	1
Sardinella (*Sardinella aurita*, *S. maderensis*, *Sardinella* spp.)	SAA, SAE, SIX	1N	1
Sardinella (*Sardinella aurita*)	SAA	4S, 5S	3-5
Sardinella (*Sardinella maderensis*)	SAE	4S, Nigeria	3-5
Sardinella spp.	SIX	2S, 9S	3-5
Horse mackerel (*Trachurus trachurus*, *T. trecae*)	HOM, HMZ	1N	1
Horse mackerel (*T. trecae*) and other Carangidae	HMZ, CGX	3S, 4S, 9S	3-5
Chub mackerel (*Scomber colias*)	VMA	1N	1
Anchovy (*Engraulis encrasicolus*)	ANE	1N, 4S, Congo	1 (N)/3-5 (S)
Bonga (*Ethmalosa fimbriata*)	BOA	1N, Guinea, Nigeria, 4S, 8S	1 (N)/3-5 (S)
Scads nei (*Decapterus* spp.)	SDX	Guinea	3-5
European Hake (*Merluccius merluccius*)	HKE	Morocco	1-4
Black hake (*Merluccius polli* + *M. senegalensis*)	HKB, HKM	Mauritania	1-4

[66] http://firms.fao.org/firms/en

[67] Please note that we have renamed some shared stocks following the codes in Table 3.1: 1N, 2N, 3N, 2S, 3S, 4S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 13S to facilitate editing in this report, although those codes are not used by CECAF.

Benguela hake (*Merluccius polli*)	HKB	Angola	2-6
Catfish (*Arius* spp.)	AWX	3N, 1S, 7S	1-4 (N)/2-6 (S)
Croakers (*Pseudotolithus* spp.)	CKW	3N, 1S, 4S, 5S, 11S	1-4 (N)/2-6 (S)
White grouper (*Epinephelus aeneus*)	GPW	2N	1-4
Blue spotted seabream (*Pagrus caeruleostictus*)	BSC	2N	1-4
Pargo breams nei (*Pagrus* spp.)	SBP	Morocco	1-4
Large-eye dentex (*Dentex macrophthalmus*)	DEL	2N, Angola	1-4 (N)/2-6 (S)
Dentex nei (*Dentex* spp.)	DEX	4S, S. Tome, 10S	2-6
Red Pandora (*Pagellus bellottii*)	PAR	2N, 4S	1-4 (N)/2-6 (S)
Axillary seabream (*Pagellus acarne*)	SBA	Morocco	1-4
Sea breams (*Pagellus* spp.)	PAX	Morocco, 12S	1-4 (N)/2-6 (S)
Sargo breams nei (*Diplodus* spp.)	SRG	Cabo Verde	2-6
Sea breams (Sparidae)	SBX	1S	2-6
Rubber-lip grunt (*Plectorhinchus mediterraneus*)	GBR	Morocco	1-4
Bobo croaker (*Pseudotolithus elongatus*)	PSE	1S	2-6
Threadfin (*Galeoides decadactylus*)	GAL	1S, 4S, 6S, 11S	2-6
Grey grunt (*Pomadasys* spp.)	BGX	1S, 10S	2-6
Sole (*Cynoglossus* spp.)	YOX	1S, 5S, 8S, Angola	2-6
Grouper (*Cephalopholis taeniops*)	EFA	Cabo Verde	2-6
Moray eel (Muraenidae)	MUI	Cabo Verde	2-6
West African goatfish (*Pseudupeneus prayensis*)	GOA	Cabo Verde	2-6
Amberjacks nei (*Seriola* spp.)	AMX	Cabo Verde	2-6
Bigeye grunt (*Brachydeuterus auritus*)	GRB	4S, Nigeria, 13S	2-6
Deepwater rose shrimp (*Parapenaeus longirostris*)	DPS	Morocco, Mauritania, 2N, 3N, G. Bissau, Congo, Angola	1-4 (N)/2-6 (S)
Southern rose shrimp (*Penaeus notialis*)	SOP	Mauritania, 3N, G. Bissau, Guinea, Ghana, Congo	1-4 (N)/2-6 (S)
Coastal shrimps	CRU	5S, DR Congo	2-6
Octopus (*Octopus vulgaris*)	OCC	Dakhla, Cap Blanc, 3N, G. Bissau	1-4 (N)/2-6 (S)
Cuttlefish (*Sepia officinalis*)	CTC	Dakhla, Cap Blanc, 3N	1-4
Cuttlefishes nei (*Sepia* spp.)	IAX	G. Bissau, Guinea, Ghana,	2-6
Squid (*Loligo vulgaris*)	SQR	Dakhla, Cap Blanc, 3N	1-4

Information on the total landings by species and gear type is not available, due to problems associated with monitoring specific fisheries data collection, including: geographical coverage; unreported by-catch; discards and especially Illegal; unreported and unregulated (IUU) fishing constitute a major problem in CECAF. The statistics provided by the countries are sometimes incomplete, irregular or obsolete in the assessment WGs.

The catches registered in the FAO Fisheries Statistical Collections website for CECAF[68] show a relatively steady trend in the most recent three years period available (2013-2015), with an average of 3.9 million tons of total catch for all species. Small pelagics account for about 76% of the total landings, with Sardinella representing half of them, especially in the north[69]. Finfish constitute the most important demersal group in landings, particularly in the south (87%). Landings of cephalopods are especially important in the north (mainly in Dakhla and Cape Blanc), where they reach 56% of the total landings[19]. Data on total fishing effort deployed in CECAF are not available.

[68] FAO. Fisheries and Aquaculture Department: http://www.fao.org/fishery/statistics/cecaf-capture-production/query/en
[69] Source: 7th Session of the Scientific Subcommittee of CECAF (FAO, 2016): http://www.fao.org/3/a-i5301b.pdf

The stock identity for assessment purposes is considered by the WGs, using a geopolitical set of criteria, and conditioned by the activity of the fleets targeting widely distributed stocks, spreading among several countries, and the availability of information disaggregated by species.

A Schaefer logistic production model has been generally applied by CECAF for the assessment of both small pelagics and demersal stocks. In those stocks with information available, analytical models are also used. However, in many cases data availability is limited and inadequate for stocks assessment; thus, the results are inconclusive in almost 30% of the stocks assessed.

The last assessments accepted by the Committee showed that of the 23 small pelagic stocks assessed, 8 were overexploited, 7 fully exploited, 3 under-exploited, and 5 did not have reliable results from the assessments. Of the 73 demersal stocks assessed, 20 were overexploited, 13 fully exploited, 17 under-exploited, and 23 did not have reliable results.

CECAF is not a management organisation and therefore it lacks the power to establish regulatory measures. As an advisory body it only makes recommendations on management measures to the Coastal States. In general, the WGs organized by CECAF recommend the fishing effort or catches for each stock to be exploited at an optimum level. The recommendations are made in a general manner to allow the Coastal States to decide on the most appropriate management measures for their resources. In fact, the only existing quotas in some CECAF countries are decided by their national administrations.

The decreasing proportion of the DWFN production during the last decades is noteworthy, while the production from the Coastal States has increased due to their exploitation of the fishing resources within their EEZs. In fact, the proportion of the DWFN production in the total fishery has sharply diminished, from 57.5% in 1977 to 16.7% in 2013 (FAO, 2016a). Most of the fishing products are marketed in the Africans coastal countries and subsequently exported to other continents, mainly Europe (70%), and Asia (15%). Only 11% of the export markets in Africa are to other African countries (mainly Nigeria, Ghana and Côte d'Ivoire)[70].

A1.2.3. Description of Sensitive Species and Habitats

CECAF lacks regulatory power to establish any spatial management measure. However, it should be noted that a small portion of the central eastern Atlantic falls under the competence of both CECAF and SEAFO. In 2011, SEAFO (with regulatory powers) designated a VME in the overlapping area and closed it to bottom fishing (Fig. A1.2.1) (CECAF, 2016c)[71].

The FAO/CECAF Technical Workshop on Deep-sea fisheries and Vulnerable Marine Ecosystems in the Eastern Central Atlantic (FAO, 2017) provided the first guidance for sustainable deep-sea bottom fisheries and protection of VMEs, in relation to the FAO Deep-sea Fisheries Guidelines. This workshop summarized a set of specific points for consideration by the CECAF SSC. The recommendations follow common practice as undertaken in other regions, and support the application of relevant parts of UNGA resolutions on bottom fisheries and VMEs, the FAO Code of Conduct for Responsible Fisheries, and the FAO Deep-sea Fisheries Guidelines. The workshop report is considered as the basis of further discussions on deep-sea fisheries footprints and the characterization of VMEs.

The identification of VME indicator taxa (and associated thresholds for various fishing gears), the use/development of identification guides for fish species and for VME taxa in the CECAF area and training for observers onboard fishing vessels were some of the recommendations made in relation to VME indicators.

[70] http://www.fao.org/in-action/globefish/fishery-information/resource-detail/es/c/338418/
[71] Vulnerable marine ecosystem (VME) closures in the CECAF Area: http://www.fao.org/fishery/docs/DOCUMENT/cecaf/cecaf21/6e.pdf

Although VMEs have not been defined by CECAF for the reasons explained above, there are some indications on the occurrence of vulnerable ecosystems in the EEZs of some Coastal States that should be considered by national authorities for their potential designation as VMEs.

The only published information on VMEs available in the CECAF area refers to the Mauritanian slope, collected and analysed from the Spanish and German surveys carried out between 2007 and 2010 (Ramos *et al.*, 2017a-e; Sanz *et al.*, a, b; Freiwald *et al.*, 2012). An inventory of the biodiversity and ecosystems off Mauritania deep-waters based on four surveys carried out with the Spanish R/V *Vizconde de Eza*, as well as subsequent studies on benthos developed within the framework of the EcoAfrik project (IEO–University of Vigo) is available in Ramos *et al.* (2017a). The whole Mauritanian slope between 100 and 2000 m depth was mapped by multibeam echo sounder and detailed bathymetry was recently made available in Sanz *et al.* (2017a, b) and Ramos *et al.* (2017c, d). Three main vulnerable hard-bottom habitats were located and characterized at geo-morphological, oceanographic and faunistic level. In addition, sensitive species were listed for the first time in a West African zone belonging to CECAF (Sanz *et al.*, 2017a, b; Ramos *et al.*, 2017c, d). The three vulnerable areas described for the Mauritanian slope are:

1. **Barrier of cold-water coral mounds.** This is a giant structure with 100 m height above the sea floor and about 1700 m wide that runs parallel to the shelf-break between 400-550 m depth. The structure stretches for almost 600 km along the Mauritanian slope from the Senegal River, in the south, to the Tanoûdêrt Canyon, in the north, and constitutes the world's largest known barrier of deep-water coral mounds, mainly *Lophelia pertusa* (Hovland, 2008; Ramos *et al.*, 2017c; Wienberg *et al*., 2018). This reef constitutes a unique paleo-climatic archive of international scientific importance. In addition, the carbonate reefs have a great ecological interest because they are in an oxygen-depleted layer. The presence of these two joint features results in a physical barrier that separates shallow and deep faunistic assemblages. In addition, the ROV exploration carried out during the German cruises discovered the existence of rich and living *L. pertusa* and *Madrepora oculata* reefs in well-defined areas along the Mauritanian slope. At least 150 macrobenthic species were recorded in the carbonate mound barrier.

2. **Arguin and Timiris Canyons**. The Northern Mauritanian slope, in front of the Banc d'Arguin, harbours almost 30 sinuous channels and canyons grouped in four major systems (Tanoûdêrt, Arguin, Louik and Timiris) (Sanz *et al.*, 2017a). The canyons, over 8-70 km length, can reach up to 700 m depth and have very steep walls with slopes of about 50%. The Arguin Canyon extends several hundred kilometres to the middle of the Atlantic Ridge (Antobreh and Krastel, 2006). The complete mapping of these canyons was made during the Spanish surveys (Ramos *et al.*, 2017b, d; Sanz *et al.*, 2017a). Rich communities of suspension feeders composed by corals (*L. pertusa* and *Dendrophyllia cornigera*), sponges, hydrozoans, gorgonians and bryozoans were found in the edges of several canyons at depths ranging from 240 to 525 m (Ramos *et al.*, 2017d). The ROV dives during the 2010 German campaign observed flourishing deep-water coral communities (*L. pertusa* and *M. oculata*) with high biological diversity at the Tanoûdêrt and Nouamghar-Inchiri canyons (Freiwald *et al.*, 2012). These zones were characterised by the presence of large sponges, high populations of the bivalve *Acesta excavata* and of the giant deep-sea oyster *Neopycnodonte zibrowii*, and octocoral gardens of *Paramuricea* sp. and *Thesea talismani*.

3. **Wolof's seamount.** A 200m high knoll, which was discovered and mapped during the Spanish surveys in Mauritania (Sanz *et al.*, 2017a, b). The small seamount is located on the upper continental slope, at approximately 90 km south of Nouakchott (17°08'50''N and 16°46'38''W). It is an isolated conical salt diapir that raises 200 m from the surrounding seabed, with small ridges, almost parallel to the edge of the continental shelf, and independent of the coral mounds barrier. A particular assemblage composed by sponges, mainly belonging to the genus *Geodia* (*G. megastrella* and *G.*

barretti) and the ophiuroid suspension feeder *Ophiothrix maculata* was found over its summit (Sanz *et al.*, 2017b; Calero *et al.*, 2018).

Considering the vulnerable habitats discovered in these recent studies, a first proposal to create a network of Marine Protected Area (MPAs) on the Mauritanian slope has been recently submitted by a panel of experts to the Mauritanian Government (Ramos *et al.*, 2018).

On the slopes of Morocco and Western Sahara waters, long-living sponge grounds, gardens of cnidarians (sea-fans, bamboo corals, antipatharians, sea-pens, hydroids) and cold-water corals structures were discovered during the three Spanish *Maroc* surveys carried out between 2004 and 2006 onboard the R/V *Vizconde de Eza* (Ramos *et al.*, 2015; Ramos *et al.*, in press). These habitats still need to be further studied, mapped and their fauna inventoried.

In Cabo Verde islands, rich suspension feeder assemblages were located during the CCLME survey in 2011 (Krakstadt *et al.*, 2011a). A rich and very diverse assemblage of demosponges, cnidarians (sea fans, black corals, bamboo corals and hydroids) and accompanying fauna inhabits mainly the shelf and upper slope of Maio and Boa Vista islands (Ramos *et al.*, in press).

Some indicators of vulnerable ecosystems, especially black corals, were collected in the seamounts of Sierra Leone Rise during the *Palguinea* longline survey in 2001 (Ramos, 2001).

A recent survey of the German R/V *Meteor* located carbonate structures on the Angolan slope, mainly constituted by *L. pertusa* and like those described for Mauritania (Hebbeln *et al.*, 2016).

Although there is not an official list of indicator species/taxa adopted by CECAF, some species/taxa commonly used as indicators in other zones have been reported in the area, more specifically in waters off Mauritania, which is the best studied area and/or off Morocco and Western Sahara. The following list of potential indicators species in CECAF has been extracted from the works of Calero (2017); Calero *et al.* (2017); Castillo (2017); Gil (2017); Gil & Ramil (2017); Ramos *et al.* (2017f, Ramos *et al.* in press) and other works still in preparation or submitted to be published.

Table A1.2.2 VME Indicator species.

	Species/taxa		**Species/taxa**
CNIDARIA (CNI)		**PORIFERA (POR)**	
Alcyonacea (AJZ)	*Acanella arbuscula*	Demospongiae (DMO)	*Chondrocladia* sp.
	Acanthogorgia armata		*Geodia barretti*
	Chrysogorgiidae		*Geodia megastrella*
	Paramuricea grayi		*Isops pachydermata*
	Swiftia dubia		*Leiodermatium lynceus*
	Thesea talismani	Hexactinellida (HXY)	*Aphrocallistes beatrix*
Antipatharia (AQZ)	*Stylopathes* spp.		*Hyalonema* spp.
Hydrozoa (HQZ)	*Lythocarpia myriophyllum*		*Pheronema carpentieri*
	Aglaophenia spp.		*Regadrella phoenix*
	Nemertesia spp.	**MOLLUSCA (MOL)**	
	Sertularella spp.	Bivalvia	*Acesta excavata*
Pennatulacea (NTW)	*Funiculina quadrangularis*		*Neopycnodonte zibrowii*
	Pennatula rubra.	**ECHINODERMATA (ECH)**	
	Umbellula huxleyi	Crinoidea	*Antedon bifida moroccana*
Scleractinia (CSS)	*Lophelia pertusa*		*Leptometra celtica*
	Madrepora oculata		
	Dendrophyllia cornigera		
	Caryophyllia sarsiae		
	Javania cailleti		

A1.2.4. Assessment of impacts upon sensitive species and habitats

There are no regular fishery independent surveys to measure significant adverse impacts (SAI) in CECAF. Some information has been collected in fishing vessels (i.e. IEO Programs of observation onboard EU demersal deep-sea trawlers).

Some recommendations established in the FAO/CECAF Technical Workshop on Deep-sea fisheries and Vulnerable Marine Ecosystems in the Eastern Central Atlantic (FAO, 2017) included the consideration of scientific surveys, with a priority given to deeper areas that have not been previously fished or where limited fishing has occurred (e.g. seamounts), to investigate the abundance and distribution of potentially new deep-sea resources, and/or the presence of VMEs or other sensitive communities, habitats and species. Where possible, multi-disciplinary surveys should be conducted and undertaken cooperatively to maximise synergy and training opportunities.

However, the problem of funding these surveys in the CECAF area was raised during the Workshop. It was noted that the cooperation of commercial fishing vessels made possible the collection of much of the information used in many other regions, both for deep-sea fisheries and VME indicator species and for sea bottom mapping. This was suggested as a possibility for CECAF to consider.

Based on available information, it was recommended that a procedure be designed for the identification of likely or known VME and assess the risk of SAI from fisheries using bottom contact gears. Mitigation measures should be adopted, as necessary.

A1.2.5. Mapping of sensitive species and habitats

There are no *ad hoc* scientific surveys for mapping sensitive areas in West Africa coordinated either by CECAF or by the Coastal States. However, important information on sensitive species and habitats has been collected in the area in deep-sea oceanographic surveys, initially planned for other purposes.

This is the case of the Spanish trawl surveys *Maroc* and *Maurit*, both carried out onboard the R/V *Vizconde de Eza*. The *Maroc* surveys were conducted from 2004-2006 with the main aim of prospecting and assessing the deep-sea fishing resources in the continental shelf and slope off Morocco and Western Sahara between 200 and 2000 m depth. This first aim was completed with specific objectives that included taxonomic studies and inventory of benthic biodiversity, bathymetric and geomorphological description of the sea-bottom and detailed maps and bottom digital model. The *Maurit* surveys were carried out from 2007-2010. Although the overall aim of the two first surveys was the exploration and evaluation of existing demersal resources in the continental shelf and slope off Mauritania between 80 and 2000 m depth, the discoveries made led to the extension of these goals in the latter two surveys, including the characterization of demersal, benthic communities and Vulnerable Marine Ecosystems (Ramos *et al.*, 2017a).

This is also the case of the IEO Pilot Action *Palguinea,* for the prospection of deep sea resources by long-line in the seamounts of Sierra Leone Rise (Ramos, 2001) during which a small ROV (Remotely Operated Vehicle) was used to capture video of the shallowest seamount and some benthic samples of vulnerable species.

There is also some limited information from other industries about benthic habitats (e.g. in Mauritania) initial benthic information came from seismic exploration and preliminary surveys carried out by oil companies (Colman *et al.*, 2005; FAO, 2017).

The original purpose of the German expedition *Maria S. Merian* 16-3 was to study the complex sedimentary system off Mauritania as an atypical tropical ecosystem and an archive of paleoclimatic change in Africa in the Holocene. The expedition exceeded the goals initially formulated and the general morphology, ecology and preliminary biological inventory of the Mauritanian cold-water coral habitats was for the first time researched by conducting visual inspection and sampling of benthic organisms using an ROV (Freiwald *et al.*, 2012).

It is worth noting that the R/V *Meteor* German expedition M122 focused on the investigation of cold-water coral (CWC) occurrences in the Southeast Atlantic Ocean, including waters off Angola, belonging to CECAF. This was conducted in a region characterized by a distinct oxygen minimum zone, with the aim of studying the distribution, the appearance, the faunal assemblage and status of these ecosystems under present and past (glacial) conditions (Hebbeln *et al.*, 2016).

Three CCLME ecosystem surveys were undertaken onboard the R/V *Dr Fridtjof Nansen* in 2011 and 2012 as part of a wider cooperation framework between the EAF-Nansen Project of FAO, the Canary Current Large Marine Ecosystem (CCLME) and the institutions within the countries belonging to the area of the CCLME region, which extended from Morocco and Guinea, including Cabo Verde (Krakstad *et al.*, 2011a, 2011b, 2012). The 2011 *Fridtjof Nansen* Survey made the remarkable discovery of high-diverse and virgin suspension feeder communities constituted by vulnerable species, mainly sponges and cnidarians, in the Maio-Boa Vista islands' shelf (Krakstad *et al.*, 2011a; Ramos *et al.*, in press). Besides, these surveys provide a baseline assessment of the shelf and slope biodiversity and marine environment at depths between 20 -500 m, including the collection of benthic invertebrates, which is still under study and that will provide further information on sensitive areas or habitats.

Some relevant information has also been collected by observers onboard Spanish fishing trawlers that carry out deep-sea fisheries in waters off Morocco, Mauritania and Guinea-Bissau through Sustainable Fisheries Partnership Agreements (SFPAs) between the EU and these coastal States. These programs of observers onboard have been designed and developed to give answer to the requirements of the EU Data Collection Framework (DCF). Data on catch and discards composition and abundance are collected by the observers. They represent a potential source of information on VME indicator species presence and location, but this data has yet to be analysed and assessed.

A1.2.6. Impact mitigation and protection

As CECAF is not an RFMO it therefore does not have a Regulatory Area. As explained above, the area of competence of CECAF matches with the FAO Major Fishing Area "34 – Eastern Central Atlantic" and comprises both the EEZs of coastal countries and ABNJ, from Cape Spartel to the River Congo. With regards to this Convention Area, there is a general agreement to expand the Convention Area southward to include Angola, as its coast borders the FAO Fishing Area "47 – Southeast Atlantic". The inclusion of Angola in CECAF area of competence would thus formalize a "de facto" situation, as the CECAF Scientific Sub-Committee and its WG meetings also cover Angolan fishery resources (FAO, 2016b) .

The statistical area FAO 34 is sub-divided in four subareas, further sub-divided into twelve divisions, some of them with sub-divisions[72]:

1. Northern Coastal (Subarea 34.1), split into 3 divisions:
    - Morocco Coastal (Division 34.1.1), divided into three subdivisions.
    - Canaries/Madeira Insular (Division 34.1.2)
    - Sahara Coastal (Division 34.1.3), divided into two subdivisions.
2. Northern Oceanic (Subarea 34.2), which includes only one division.
3. Southern Coastal (Subarea 34.3), divided into six divisions:
    - Cape Verde Coastal (Division 34.3.1), divided into three subdivisions.
    - Cape Verde Insular (Division 34.3.2)
    - Sherbro (Division 34.3.3)
    - Western Gulf of Guinea (Division 34.3.4)
    - Central Gulf of Guinea (Division 34.3.5)

[72] http://www.fao.org/fishery/area/Area34/en

- Southern Gulf of Guinea (Division 34.3.6)

4. Southern Oceanic (Subarea 34.4), divided into two divisions:
    - Southwest Gulf of Guinea (Division 34.4.1)
    - Southwest Oceanic (Division 34.4.2)

During the FAO/CECAF Technical Workshop on Deep-sea fisheries and Vulnerable Marine Ecosystems in the Eastern Central Atlantic (FAO, 2017), it was suggested to develop an Exploratory Fishing Protocol to guide CECAF member States in the development of new deep-sea fisheries using bottom contact gear in areas that have not previously been fished during a historical reference period. To ensure regional consistency, it was recommended that the plan should be based on the SEAFO protocol, including a harvest plan, a mitigation plan, a catch monitoring plan, a data collection plan, and any additional information. Procedures for the submission and assessment of a "Notice of Intent" to conduct a new fishery should be developed.

The following draft encounter protocol text was proposed for CECAF region:

Prior to undertaking exploratory bottom fishing, the Member Country shall gather relevant data to facilitate assessments of exploratory bottom fishing by the Scientific Sub-Committee.

The relevant Member Country shall forward a "Notice of Intent" that will include:

i. historical information- desk review of the target species, type of fishery, biology of the species (if applicable) and any other information deemed necessary;
ii. harvesting plan- target species, dates and areas and the type of bottom fishing gear;
iii. mitigation plan- measures to prevent SAIs to VMEs that maybe encountered during fishing;
iv. catch monitoring plan; recording/ reporting of all species caught (this shall include adequate reporting of by-catch, discards and their locations for the maintenance of VME health)
v. sufficient system for recording/ reporting of catch; including VMS reporting of catch and electronic logbook if possible
vi. data collection plan to facilitate the identification of VMEs in the area fished; including deck photos, and/or samples for later analysis.

If an encounter is discovered:

i. for bottom trawling - the vessel master shall cease fishing and move away at least 2 nautical miles from the end point of the trawl tow in the direction least likely to result in further encounters, defining a buffer area with a two nautical mile radius;
ii. for bottom fishing gear other than bottom trawls - vessel shall cease fishing and move away at least 1 nautical miles from the position that the evidence suggests is closest to the exact encounter location, defining a buffer area with a 1 nautical mile radius;
iii. the master shall report the incident, including the estimated position of the encounter, without delay to its flag State, which shall forward the information to the Executive Secretary. This applies to all gears.

A1.2.7. Monitoring of VME impacts

CECAF is a RFB without regulatory powers and cannot establish management or conservation measures. However, as a coordinating body, CECAF is able to provide guidance and advice to its members in relation to monitoring. Coastal States are required to identify and establish VMEs on a voluntary basis and to monitor them according to their own legislation. In this respect a proposal to

create a network of MPAs on Mauritanian slope has recently been submitted to the Mauritanian Government (Ramos *et al.*, 2018) which also includes a scientific monitoring plan for the protected areas.

A1.3. GFCM

A1.3.1. Organisation, Data and Governance

The General Fisheries Commission for the Mediterranean (GFCM) is a regional fisheries management organization (RFMO) established under the provisions of Article XIV of the FAO Constitution. The GFCM initially started its activities as a Council in 1952, and it became a Commission in 1997.

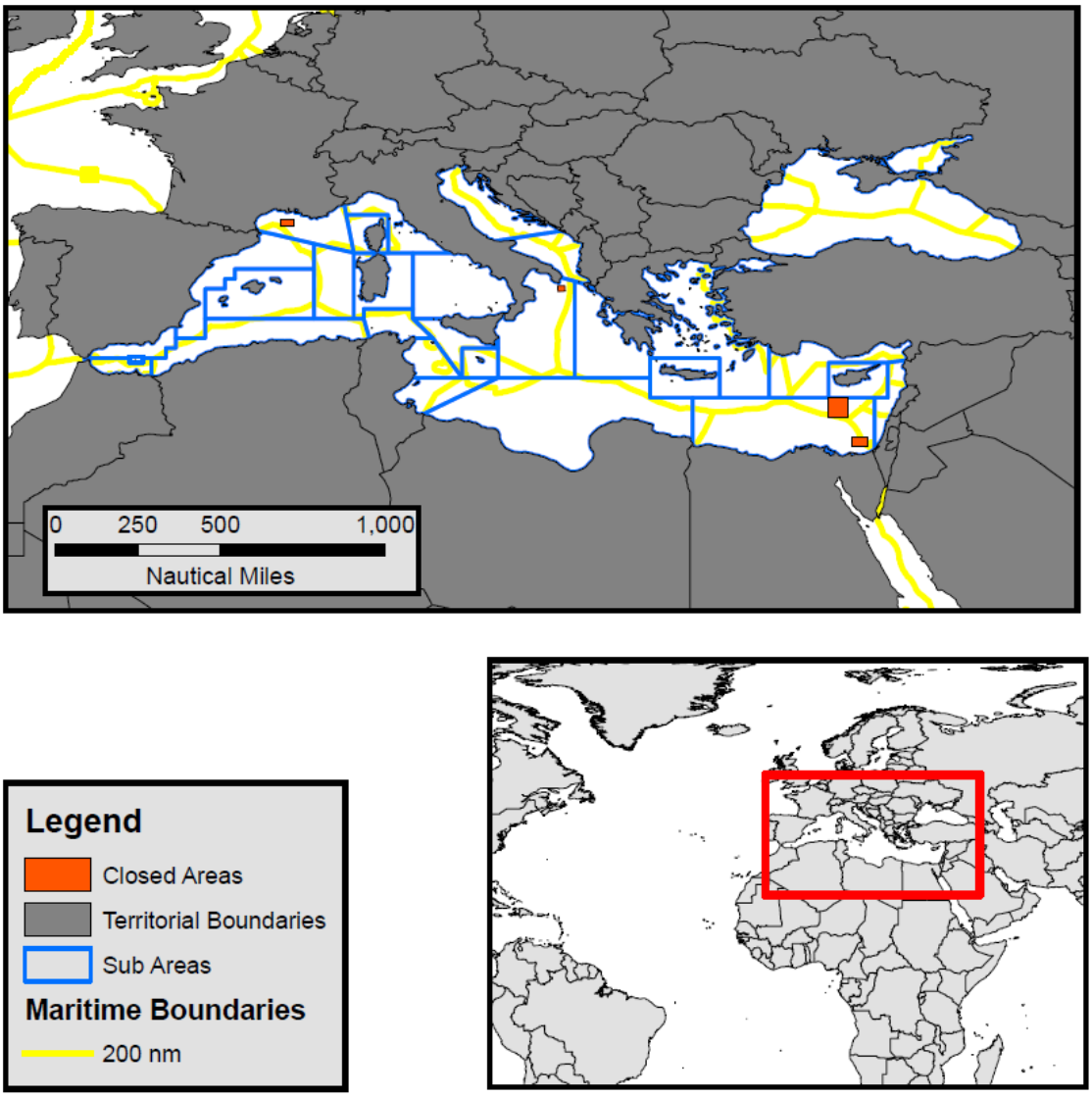

Figure A1.3.1 – Sub areas and benthic closed areas in the GFCM Area. In addition, areas below 1000m depth are closed to bottom contacting gears (trawls and dredges). Red area on bottom-right panel indicates extent of top panel.

Its main objective is to ensure the conservation and the sustainable use, at the biological, social, economic and environmental level, of living marine resources, as well as the sustainable development of aquaculture in the Mediterranean and in the Black Sea (GFCM area of application) (Fig. A1.3.1).

The GFCM is currently composed of 24 members (23-member countries and the EU), who contribute to its autonomous budget, and 3 cooperating non-contracting parties (Bosnia and Herzegovina, Georgia and Ukraine).

Membership is open to Member and Associate Members of the Organization and non-member States, i.e. UN members, or any its specialized agencies that are coastal States or regional economic

organizations whose vessels engage in fishing in its area of application.

The GFCM implements its policy and activities through its Secretariat, based in Rome, Italy. The Commission holds annual sessions and operates during the intersession by means of its committees: The Scientific Advisory Committee on Fisheries (SAC), the Scientific Advisory Committee on Aquaculture (CAQ), the Compliance Committee (CoC), the Committee of Administration and Finance (CAF) and their subsidiary bodies, including the Working Group for the Black Sea (WGBS). The GFCM Bureau steers strategic orientations to the Commission and the Secretariat (Fig. A1.3.2).

Figure A1.3.2 – Organizational structure in GFCM.

The Commission has the authority to adopt binding recommendations for fisheries conservation and management in its area of application and plays a critical role in fisheries governance in the region. It can regulate fishing methods, fishing gear and minimum landing size, establish fishing seasons, fisheries closures, and control fishing effort. In cooperation with other RFMOs, the GFCM plays a decisive part in coordinating efforts by governments to effectively manage fisheries at the regional level following the FAO Code of Conduct for Responsible Fisheries (CCRF). Moreover, it closely cooperates with other international organizations in matters of mutual interest and it benefits from the support of cooperation projects and programmes at the regional and sub-regional level to enhance scientific cooperation and capacity-building among its Contracting Parties.

Under the Committees there are several working groups which focus on specific topics. These groups may be concerned with internal affairs only, or work jointly with other organizations:

- WGSAD: Working group on stock assessment of demersal species.
- WGSASP: Working group on stock assessment of small pelagic species.
- WGIUU: Working group on illegal, unreported and unregulated fishing in the GFCM area of application.
- WGVMS: Working group on Vessel Monitoring Systems (VMS) and related control systems.
- WGVME: Working group on vulnerable marine ecosystems.
- WGEEL: Working group on eels.
- WGBS: Working group on the Black Sea.
- WGSSF: Working group on small-scale and recreational fisheries.

The GFCM has the responsibility and authority to oversee the full process of fisheries management, undertake scientific evaluations and take decisions to ensure sustainability of fisheries resources in its

area of application. The collection of data required to achieve an appropriate management of fisheries is crucial and countries should therefore provide their best available information in terms of quality and comprehensiveness.

The Data Collection Reference Framework (DCRF) was launched in 2013 to fulfil the GFCM objectives. This is the first comprehensive GFCM framework for the collection and submission of fisheries-related data in the GFCM area (Mediterranean and Black Sea). The data collected within the DCRF encompass area-based information on national fleets and their activities, catch and effort and biological information on main species, including discards and incidental catch of vulnerable species. Socio-economic data are also required to assess the economic situation of fishing enterprises and employment trends. Within the DCRF, GFCM Members should guarantee the quality and completeness of the data at the requested aggregation level and format and submit them in time to the GFCM Secretariat.

The DCRF has been approved as an instrument of the SAC to support Contracting Parties and Cooperating Non-Contracting Parties (CPCs) in complying with existing recommendations for the collection and submission of fisheries data to the GFCM. These data are of paramount importance for the work of the GFCM, to support to the decision-making process based on sound scientific advice from its subsidiary bodies.

A1.3.2. Fishing activities controlled by the organisation

The GFCM Regulatory Area includes all marine waters of the Mediterranean and Black Sea. Most bottom contacting fisheries occur between 50 and 700 m depth, but most fishing effort is located in depths of < 200 m.

Mediterranean and Black Sea waters are divided in 30 Geographical Sub-Areas (GSAs), established in 2009 to compile data, monitor fisheries and assess fisheries in a georeferenced manner. Commercial species have been classified in three different groups based on:

i) frequency of assessments (i.e. species that are assessed annually);
ii) importance of the fishery (i.e. landing, catch and/or economic value);
iii) conservation criteria (i.e. endangered species) or impact of their presence on the ecosystem (i.e. non-indigenous species).

Table A1.3.1 – Species and areas where assessments are made.

		GFCM Subregions	Western Mediterranean Sea	Central Mediterranean Sea	Adriatic Sea	Eastern Mediterranean Sea	Black Sea
		(GSAs)	*1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11*	*12, 13, 14, 15, 16, 19, 20, 21*	*17, 18*	*22, 23, 24, 25, 26, 27*	*28, 29, 30*
Species	Scientific name	FAO 3-alpha code	*Algeria, France, Italy, Monaco, Morocco, Spain*	*Italy, Greece, Libya, Malta, Tunisia*	*Albania, Bosnia and Herzegovina, Croatia, Italy, Montenegro, Slovenia*	*Cyprus, Egypt, Greece, Israel, Lebanon, Syrian Arab Repuplic, Turkey*	*Bulgaria, Georgia, Romania, Turkey, Ukraine (Russian Federation)*
Pelagics	*Engraulis encrasicholus*	ANE	X	X	X	X	X
	Sardina pilchardus	PIL	X	X	X	X	
	Sprattus sprattus	SPR					X
	Trachurus mediterraneus	HMM					X
Demersal	*Merluccius merluccius*	HKE	X	X	X	X	
	Mullus barbatus	MUT	X	X	X	X	
	Mullus surmuletus	MUR	X	X		X	
	Nephrops norvegicus	NEP	X	X	X		
	Pagellus bogaraveo	SBR	X				
	Parapenaeus longirostris	DPS	X	X	X	X	
	Scophthalmus maximus	TUR					X
	Squalus acanthias	DGS					X
Additional species	*Sarda sarda*	BON					X
	Saurida lessepsianus	SRX				X	

Group 2 fisheries target 32 species which are important in terms of landings and/or economic values at regional and sub-regional level but are assessed only occasionally. Landings in recent years (2010 – 2015) have been broadly stable, ranging between 1300 – 1400 thousand tonnes per year.

According to the latest information transmitted to the GFCM Secretariat (2017), there were 8,341 vessels > 15 m LOA fishing in the Mediterranean and Black Sea. The European fleet (all LOA sizes) registered 50,480 fishing days in 2017.

A1.3.3. Description of Sensitive Species and Habitats

GFCM adopted the FAO definition of VME at its first meeting of the WG-VME (2017) at which provisional lists of Mediterranean habitat types and representative species that may contribute to VMEs; as well as VME indicator, habitats and taxa (Table A1.3.2) were established. As an initial stage, it was proposed to select VME indicator taxa mainly at the Phylum, Class and Order taxonomic levels, as these could be more easily be identified by commercial fishing vessels.

Table A1.3.2 - Mediterranean VME Indicator Taxa. *only chemosynthetic species that indicate the presence of a cold seep or hydrothermal vent are considered.

Phylum	Class	Subclass (Order)
Cnidaria	Anthozoa	Hexacorallia (Antipatharia, Scleractinia)
		Octocorallia (Alcyonacea, Pennatulacea)
		Ceriantharia
	Hydrozoa	Hydroidolina
Porifera (sponges)	Demospongiae	
	Hexactinellida	Amphidiscophora
		Hexasterophora
Bryozoa	Gymnolaemata	
	Stenolaemata	
Echinodermata	Crinoidea	Articulata
Mollusca	Bivalvia	Gryphaeidae (*Neopycnodonte cochlear, N. zibrowii*)
		Heterodonta* (Lucinoida) (e.g. *Lucinomakazani*)
		Pteriomorphia* (Mytiloida) (e.g. *Idas modiolaeformis*)
Annelida	Polychaeta	Sedentaria (*Canalipalpata*) (e.g. *Lamellibrachia anaximandri*, *Siboglinum* spp.)
Arthropoda	Malacostraca	Eumalacostraca (Amphipoda) (e.g. *Haploops* spp.)

Oceana also presented a "Provisional list of Mediterranean habitat types and representative species

that may contribute to VMEs", collecting more than 80 representative species of 10 main VME habitat types. Some of them are included in the IUCN Red List (Table A1.3.3)

Table A1.3.3 – VME Indicator Species. IUCN Categories: EN = Endangered; CR = Critically Endangered; VU = Vulnerable.

VME habitat type	Representative Species	IUCN Red List
Cold-water coral reefs	*Lophelia pertusa*	EN
	Madrepora oculata	EN
	Desmophyllum dianthus	EN
Coral gardens	*Corallium rubrum*	EN
	Ellisellapara plexauroides	VU
	Leiopathes glaberrima	EN
	Desmophyllum dianthus	EN
	Dendrophyllia cornigera	EN
	Lophelia pertusa	EN
	Madrepora oculata	EN
	Isidella elongata	CR
Sea pen fields	*Pennatula* spp.	VU
	Pteroides spp.	VU
	Funiculina quadrangularis	VU

However, at the most recent GFCM WG-VME meeting (2018) the Commission neither took a decision regarding the above suggestions, nor adopted any VME indicators, species, habitats or VME indicator features to apply within the GFCM RA.

There are many publications about the distribution and importance of these taxa in the Mediterranean, but most focus on small study areas (e.g. Álvarez-Pérez *et al.*, 2005; Ambroso et al, 2013; Mastrototaro *et al.*, 2013) and maps providing overall wide-scale distribution of the habitats and species described in Table A1.3.3 are not yet available.

The VME habitat types are delineated by their major invertebrate constituents (sponge, coral and sea pens) and their geologic setting (continental margin, canyon or seamount). The Mediterranean stands out as a globally different region because its canyons are more closely spaced, more dendritic, shorter and steeper than canyons found in other regions of the world (Harris and Whiteway, 2011).

In the Mediterranean Sea, deep-sea coral habitats are associated with commercially important crustaceans and their abundance has dramatically declined because of trawling (e.g. Maynou and Cartes, 2012). The GFCM (2008) issued a list of identified sensitive habitats targeted by fisheries (Fabri *et al.*, 2014) including:

i) cold-water corals (*Lophelia pertusa* and *Madrepora oculata*) communities;
ii) soft mud facies with *Funiculina quadrangularis*, which is an essential habitat for valuable species (*Parapenaeus longirostris* and *Nephrops norvegicus*); and
iii) compact mud facies with *Isidella elongata*, which constitutes a relevant habitat for red shrimps (*Aristeus antennatus* and *Aristaeo morphafoliacea*).

Data availability on the distribution of VMEs are limited and variable in both quantity and quality within the RA, since most of the information has been collected for research projects conducted in relatively small areas funded by the Coastal States or by NGOs. Much of this information has been published in scientific peer-reviewed journals.

However, experts at the GFCM-WGVME meeting in 2018 showed abundant evidence of vulnerable species and habitats at depths shallower than 200 m, and it is clear that for several regions coinciding with important fisheries in the Mediterranean there are species distribution maps corresponding to potential VMEs.

A1.3.4. Assessment of impacts upon sensitive species and habitats

There are currently no standardized international scientific surveys coordinated by CPs to monitor VMEs in the Mediterranean and Black Sea. Some national scientific surveys (i.e. INDEMARES project in Spain) have been carried out in some geographical features to study the deep-sea benthos, but the protocols are not standardized. MEDITS is an annual standardized fishery independent bottom trawl survey carried out mostly by EU-GFCM countries, but also by Morocco, Montenegro and Turkey (MEDITS Handbook, 2016).

There are some studies concerning the impact of GFCM fisheries operating on benthic ecosystems, specially the impact of the bottom trawlers (e.g. Smith at al., 2000; Pranovi *et al.*, 2000), but most are of limited geographical scope.

A1.3.5. Mapping of sensitive species and habitats

The MEDITS survey (since 1994) is an important source of information to comply with EU and GFCM requests in terms of fisheries data collection, including the design of indicators for biodiversity, food webs, contaminants and pollution effects in seafood, marine litter, and improvements in species identification. The first years of MEDITS (1994-2001) were co-financed by the European Union Commission Directorate General for Fisheries (DGXIV), while from 2002 the survey has been co-funded by the EU through the European Fisheries Fund (EFF) and the European Maritime and Fisheries Fund (EMFF) within the Data Collection Framework for collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

The Spanish led MEDITS survey has been used to identify the occurrence of VME species and habitats, as well as the relevance of this in support of the EU Marine Strategy Framework Directive (EC, 2008). Other projects, such as LIFE+ INDEMARES, have provided additional information on deep-sea ecosystems with funding from the Spanish Government and the EU[73].

Mediterranean and Black Sea member states have developed an observer program aiming to monitor discards and bycatch of the main fisheries, mostly bottom trawl fisheries operating between 50 and 800 m. Observer records also document other fauna caught in sampled trips, but data quality and quantity depend on the objectives of the MS Observer Programme and the training and experience of observers.

Since 2006, seven Fishery Restriction Areas (FRAs) have been established to ensure the protection of deep-sea sensitive habitats and important essential fish habitats (EFH) such as spawning grounds in well-defined sites. In addition, in 2005, the GFCM prohibited the use of towed dredges and bottom trawls in all waters deeper than 1000 metres to protect little-known deep-sea benthic habitats in the Mediterranean. In 2016, this area was officially declared a FRA by the Commission.

A1.3.6. Impact mitigation and protection

The GFCM RA includes all marine waters of the Mediterranean and Black Sea, divided into five sub-regions (Western Mediterranean Sea, Central Mediterranean Sea, Adriatic Sea, Eastern Mediterranean Sea and Black Sea). Since 2009 these have been further split into 30 Geographical Sub-Areas (GSAs) (Res. GFCM/33/2009/2).

The following Fishery Restriction Areas (FRAs) have been established since 2006:

1. Large closure to towed gears for waters below 1000 m (GFCM/29/2005/1);
2. Deep sea fisheries restricted area "*Lophelia* reef off Capo Santa Maria di Leuca" (GFCM/30/2006/3);

[73] http://www.indemares.es/proyecto/descripcion

3. Deep sea fisheries restricted area "Nile delta area cold hydrocarbon seeps" (GFCM/30/2006/3);
4. Deep sea fisheries restricted area "Eratosthenes Seamount" (GFCM/30/2006/3);
5. Gulf of Lions (GFCM/33/2009/1);
6. East of Adventure Bank (CM-GFCM/40/2016/4);
7. West of Gela Basin (CM-GFCM/40/2016/4);
8. East of Malta Bank (CM-GFCM/40/2016/4).

The three FRA sites consisting of *Lophelia* reef off Capo Santa Maria di Leuca, Nile delta area cold hydrocarbon seeps and the Eratosthenes Seamount cover 15,621 km^2. The GFCM's prohibition of bottom trawling gears at depths >1000 m covers an area of 1,462,040 km^2, whereas the prohibition of bottom trawling in coastal areas up to 50 m or 3 nm covers 77,210 km^2. When combined (overlaps avoided), all these MPAs cover 1,544,267 km^2, or roughly 61% of the Mediterranean Sea area (Rodríguez-Rodríguez *et al.*, 2016).

There are standard forms for the submission of proposals for GFCM fisheries restricted areas (FRAs) in the Mediterranean and the Black Sea[74].

A1.3.7. Monitoring of VME impacts

There are no standardized international scientific surveys to monitor VMEs in the GFCM RA. Some national scientific surveys with specific goals have been carried out, but the protocols are not standardized and a range of samplers (beam trawl, benthic reaper, Van Veen dredge, ROV and other gears and methodologies) have been used.

So far there are no plans to monitor VMEs or to develop VME species identification guides. Implementation of such measures depend on the approval of the GFCM Commission following recommendations from the SAC.

[74] http://www.fao.org/gfcm/data/map-fisheries-restricted-areas

A1.4. NAFO

A1.4.1. Organisation, Data and Governance

The Northwest Atlantic Fisheries Organisation (NAFO) is the science and management body responsible for the management of fisheries in the northwest Atlantic (north of 35°00 N, west of 42°00 W; Fig A1.4.1.1), the majority of which target demersal species. The majority of the NAFO Convention area is within the Canadian and Greenland EEZs, with the NAFO regulatory area (NRA) making up the remainder of the area (at 2.71 million of 6.55 million km^2).

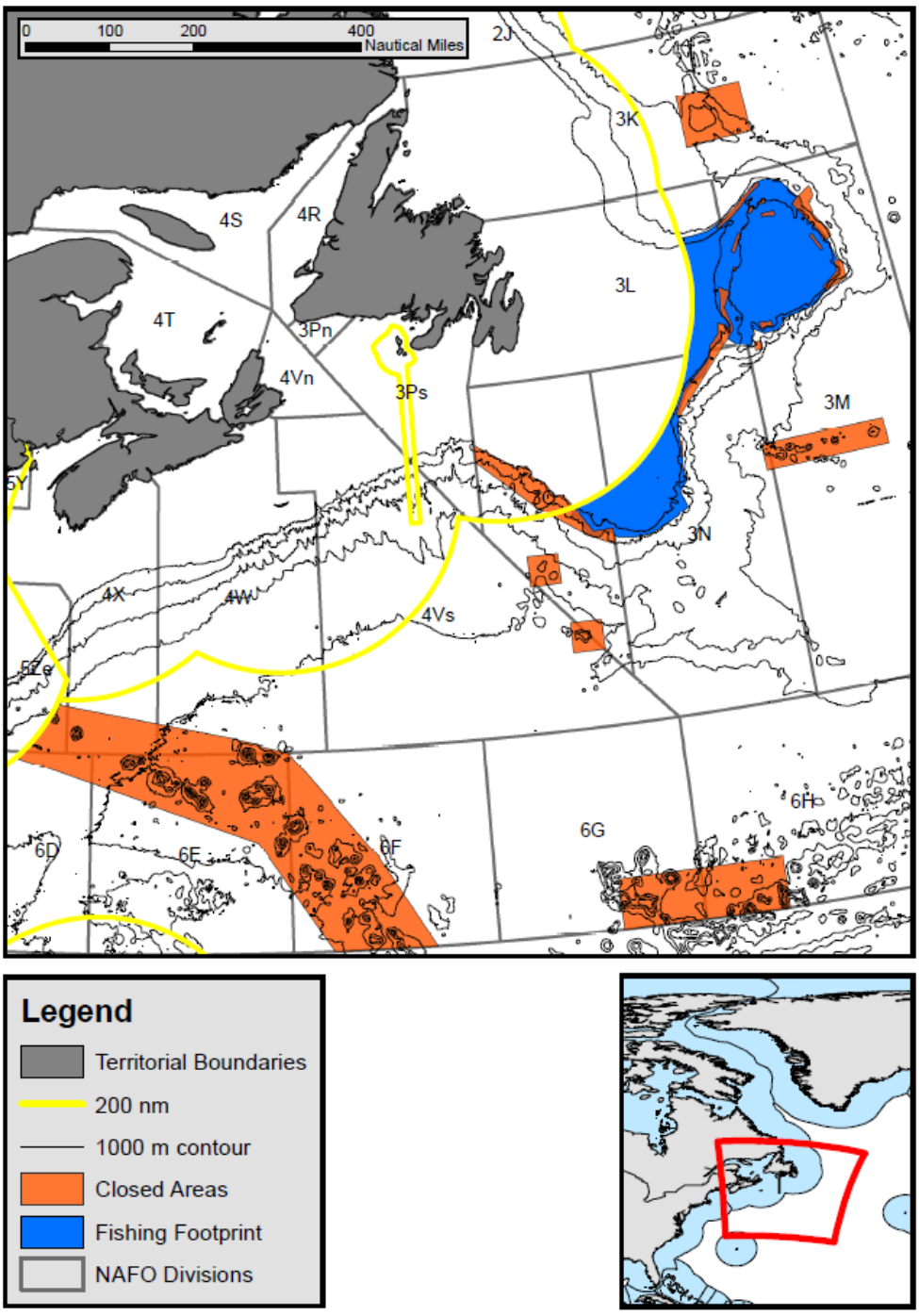

Figure A1.4.1.1 – Map of NAFO Convention Area. Contours from the GMRT v3.1 dataset. Red area on bottom-right panel indicates extent of top panel

NAFO was founded in 1979, following the dissolution of the International Commission of the Northwest Atlantic Fisheries (ICNAF, 1949-1978). The aim of the NAFO Convention is to ensure the long-term conservation and sustainable use of the fishery resource in its area, and safeguard the marine ecosystems in which these resources are found.

There are 12 official Contracting Parties, though Denmark represents the Faeroe Islands and Greenland, so in practice 14 countries are represented at the Commission. These countries are Canada; Cuba; Denmark (representing Greenland and the Faeroes); the EU; France (representing St Pierre et Miquelon); Iceland; Japan; Norway; South Korea; the Russian Federation; Ukraine and the USA. Contracting Party status is contingent upon either being a coastal state or levels of historic and expected future fishing activity.

NAFO is divided into a Secretariat, the Commission and the Scientific Council (Fig. A1.4.1.2). The secretariat is based in Halifax and is comprised of 11 full time staff, led by an executive secretary who is appointed by the Commission. The secretariat provides administrative support to the Commission and Scientific council.

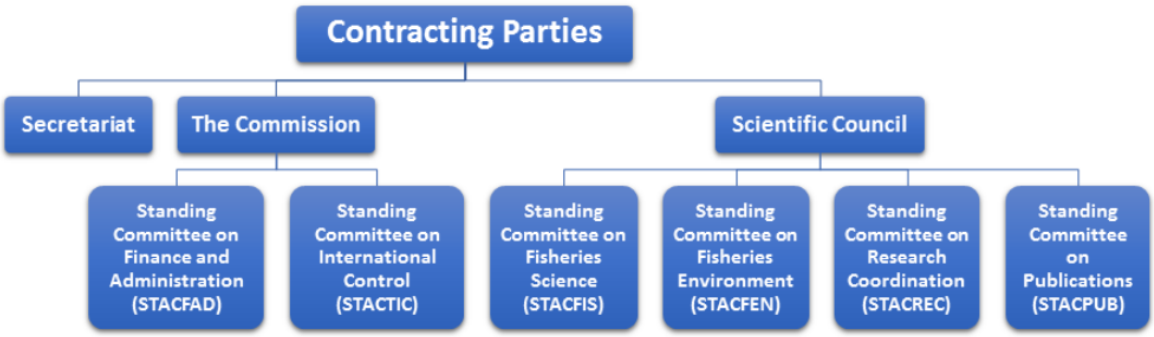

Figure A1.4.1.2 – NAFO Organisational Structure.

The Commission is a joint meeting between the General Council and the Fisheries Commission (FC) and is the forum for the Contracting parties to supervise and coordinate the internal affairs of the Organisation. The Commission is responsible for the management of the marine resources in the NAFO convention area and takes advice from the Scientific Council. The Commission has two standing committees; the Finance and Administration committee (STACFAD) and the Committee on International Control (STACTIC). STACFAD works closely with the Secretariat and is responsible for the Organisation's budget and matters relating to meetings and publications and is staffed by representatives from at least five of the Contracting Parties (CPs), with additional experts as required. STACTIC is staffed by at least one representative for each CP and is responsible for a range of the Convention's operational requirements, including:

a) evaluating the effectiveness of the Convention's Conservation and Enforcement Measures (CEMs);
b) evaluating compliance by the CPs with the CEMs and following up on suspected infringements;
c) evaluating inspection and surveillance records submitted by the CPs;
d) developing surveillance and inspection methodologies and coordinating CP activities;
e) collect and compile information on fishing and trans-shipment activities in the NRA by CPs and non-CPs;
f) compiling reports and making recommendations to the Commission.

The Scientific Council compiles and maintains statistics and records relating to the fisheries and their associated environments. Upon request, it provides advice on the conservation and management of fishery resources in the Convention area to the Commission and coastal states. Each CP is a member of the SC and appoints its own representatives. The SC has four standing committees, as well as a number of working groups:

- Standing Committee on Fisheries Science (STACFIS);
    - Stock assessments and assessment method development
    - Management strategy evaluation
- Standing Committee on Fisheries Environment (STACFEN);
    - Develop methods for collection and dissemination of environmental data
    - Periodic reviews of environmental status
    - Encourages CPs to collaborate in research
- Standing Committee on Research Coordination (STACREC);
    - Addresses issues relating to collection and dissemination of fisheries statistics in Convention area
    - Coordinates planning and execution of international research
    - Reviews data and information relating to fisheries biology
- Standing Committee on Publications (STACPUB);
    - Coordinates matters relating to Organisation publications

The Scientific Council and the Commission are further comprised of several working groups[75], which deal with matters relating to specific topics as follows. These groups may be concerned with internal affairs only, or work jointly with other organisations such as NEAFC or ICES:

- CESAG Catch Estimation Strategy Advisory Group[76]
- EDG STACTIC Editorial Drafting Group
- JAGDM Joint NEAFC/ NAFO Advisory Group on Data Management
- NIPAG NAFO/ ICES working group on Northern Shrimp assessment (*Pandalus* spp.)
- WG-BDS Ad hoc group on rules relating to bycatch, discards and fisheries selectivity
- WG-DEC NAFO/ ICES Joint working group on Deep-Water Ecology
- WG-E Group on improving Efficiency of NAFO WG processes
- WG-EAFFM Ecosystem Approach Framework to Fisheries Management
- WG-ESA Ecosystem Science Assessments
- WG-HARP NAFO/ ICES/ NAMMO working group on Harp and Hooded Seals
- WG-OPR Observer Programme Review
- WG-RBMS Risk-based Management Strategies

The Commission produces an annual report which summarises the Organisation's activities but detailed reports are variously produced by the Commission and the Scientific Council. These documents largely represent technical work by the organisation (e.g. stock assessments) or requests for advice by Coastal States and are usually available through the NAFO website[77]

Between 2011 and 2016, the organisation's annual budget (including voluntary contributions) has ranged € 1,200,000 – € 1,278,080[78]. Contracting Parties pay a membership fee that is, in part, proportional to their amount of catch in the year ending 18 – 24 months prior to the budget calculation (i.e. the 2016 budget used 2014 catch data). 30 % of the Organisation's budget is met equally by all CPs, with the remainder being met by CPs involved in fishing[79].

[75] This list is not exhaustive and does not include ad hoc and more temporary WGs, such as WGMSE – WG for Management Strategy Evaluation of Greenland Halibut

[76] Amalgamation of WG-CR (catch reporting) and CDAG (Catch Data Advisory Group)

[77] NAFO Documents repository: https://www.nafo.int/Library/NAFOdocuments

[78] Converted from CAN$ at CAN-EUR exchange rate of 0.640

[79] 60 % of the total is spread amongst all CPs and 10 % spread amongst coastal states only, both proportional to historic catch.

The Commission publishes an annual compliance review[80], which documents the performance of Contracting Parties against the Conservation and Enforcement Measures (CEMs)[81]. The CEM document is reviewed annually and presently consists of 55 separate articles, together with a number of technical requirements (e.g. minimum landing sizes) detailed in the annexes.

Contracting parties are responsible for submitting nominal catch data aggregated by month and fishing division, which is made publicly available on the NAFO website. Vessels are responsible for completing an event-by-event logbook file[82] and submitting daily catch records to their flag state. Since 2016 vessels are required to log haul by haul catch data. The flag states are responsible for submitting these data to the Secretariat. These records are not publicly available.

WG-ESA and WG-EAFFM are together responsible for developing recommendations for the Commission and SC to impose a spatial management regime and limit significant adverse impacts upon vulnerable marine ecosystems. Records of VMEs are predominately based upon vessels reporting 'encounters' of VME indicator species (thresholds specified in the current CEM). Upon exceeding this threshold, the master must report the encounter, cease fishing activities and move a minimum of two nautical miles.

A1.4.2. Fishing activities controlled by the organisation

Fishing vessels are required to have a vessel monitoring system (VMS) operational at all times whilst present anywhere in the Convention area. VMS reports of vessel position, speed and course are made hourly to the Contracting Party, which is responsible for transmitting the information to the Secretariat. NAFO keeps a list of all vessels suspected of illegal fishing activities and shares information with other RFMOs[83]. Fishing and trans-shipment vessels are also subject to a suite of port state measures and NAFO keeps a list of designated ports where catches made in the Convention Area may be landed and appropriately trained port state inspectors are available[84] to inspect such landings.

Non-compliance with the CEMs is usually dealt with through cases brought by individual CPs against specific vessels, either their own or vessels from another flag state. If successful, infringements typically result in a fine[85].

Based upon the distribution of historic fishing effort in the NRA, the Secretariat declared a bottom fishing area in 2009[86] known as the fishing footprint. The fishing footprint is 120,048 km^2, approximately 4.4 % of the total NRA, but around 7.0 % of this area is subject to bottom fishing closures to protect VMEs. Within the established fishing footprint, most bottom contact fisheries occur between 100 and 1200 m depth, though in Division 3N, most of the effort is expended in waters shallower than 100 m[87].

NAFO directly manages 19 stocks of 11 species[88] (Table A1.4.1) but there are more than 50 other commonly caught species, including: Yellowtail Flounder; Atlantic Halibut; Swordfish (ICCAT controlled species) and several crustacean species. There are also several stocks that are managed solely by coastal states (Canada and Greenland), for which NAFO scientists deliver advice[89].

[80] Compliance Review archive: https://www.nafo.int/Fisheries/Compliance
[81] CEM archive (annually reviewed): https://www.nafo.int/Fisheries/Conservation
[82] Logbook forms: https://www.nafo.int/Fisheries/ReportingRequirements/LogbookInfo
[83] NAFO IUU list: https://www.nafo.int/Fisheries/IUU
[84] Designated ports: https://www.nafo.int/Portals/0/PDFs/fc/PSC-forms/All_PortInfo.pdf
[85] NAFO 2016 Vessel Activity Report: https://www.nafo.int/Portals/0/PDFs/com/2017/comdoc17-27.pdf?ver=2017-10-11-134245-300
[86] NAFO Secretariat (2009). Delineation of Existing Bottom Fishing Areas in the NAFO Regulatory Area. NAFO/ FC Doc 09/20 https://www.nafo.int/Portals/0/PDFs/fc/2009/fcdoc09-20.pdf?ver=2016-02-19-063325-183
[87] 2016 Vessel Characteristics: https://www.nafo.int/Portals/0/PDFs/com/2017/comdoc17-27.pdf?ver=2017-10-11-134245-300
[88] NAFO species: https://www.nafo.int/Science/Species
[89] Coastal stocks assessed by NAFO: https://www.nafo.int/Science/Stocks-Advice/2014-special-requests-from-fisheries-commission

Table A1.4.1 – Species and management units. SA = Sub-area. Redfish are comprised of three morphologically similar species (*S. fasciatus, S. mentella, S. marinus*). *Commonly recorded as Starry Ray (*Raja radiata*)

Species	FAO Code	Management Area	Typical Assessment Interval (years)
Atlantic Cod (*Gadus morhua*)	COD	3M, 3L, 3NO	1 – 3
Redfish (*Sebastes* spp.)	RED	1F + 3K, SA2, 3LN, 3M, 3O	2
American Plaice (*Hippoglossoides platessoides*)	PLA	3LNO, 3M	2
Witch Flounder (*Glyptocephalus cynoglossus*)	WIT	2J + 3KL, 3NO	1 – 3
Greenland Halibut (*Reinhardtius hippoglossoides*)	GHL	SA2 + 3KLMNO	4
White Hake (*Urophycis tenuis*)	HKW	3NO, 3Ps	2
Thorny Skate (*Amblyraja radiata*) *	RJR	3LNO, 3Ps	2
Capelin (*Mallotus villosus*)	CAP	3NO	2
Shortfinned Squid (*Illex illecebrosus*)	ILL	SA3, SA4	3
Northern Shrimp (*Pandalus* spp.)	PAN	3LNO, 3M	1

Stocks are fully assessed on a variable time interval, but most stocks receive at least an interim assessment each year. Some species may receive additional assessment attention, following particular requests from a CP or coastal state. The Commission requests stock advice from the Scientific Council, which is then produced and published on the NAFO website[90]. Management strategy evaluation apparently operates on an *ad hoc* basis, reflecting perceived needs of specific stocks (e.g. 2010 WG on MSE for Greenland Halibut[91]).

Landings data are available via the STATLANT data portal on the NAFO website but the data are unreliable. Although it is a mandatory requirement that CPs submit catch data annually, there is significant non-compliance and the process by which the submitted data is compiled is not transparent.

In 2016, there were 47 vessels fishing in the NRA that spent 4270 days in total. The majority of these vessels are demersal trawl or longline vessels, between 500 and 2000 gross registered tonnes (86 % of all fishing days in 2016). In 2018, 69 % of the total quota was awarded to non-coastal states (mainly EU and Russia), ranging 39 – 83 % of quotas for individual stocks. It is not clear what proportion of these landings are made in coastal states or immediately exported.

A1.4.3. Description of Sensitive Species and Habitats

NAFO adopts the FAO definition of VME and has published a list of 66 indicator species[92]. The distribution of these taxa within the fishing footprint is relatively well mapped, following some dedicated surveys of invertebrate fauna and production of habitat suitability models (Fuller *et al.*, 2008; Murillo *et al.*, 2012; Knudby *et al.*, 2013a; 2013b; Barrio-Froján *et al.*, 2016). Most of the VME indicator taxa, usually modelled as a coarse grouping (e.g. Sea Pens or Gorgonians) are distributed along the Grand Banks continental slope or around the Flemish Cap. Depending upon taxa, bottom current speed, depth and temperature are common environmental drivers that contribute to predicted distribution patterns.

There are currently 21 bottom fishing closures, 15 of which are wholly, or partly, within the fishing footprint. The closures within the footprint account for 29 % of the total area of closures.

Few, if any, of the listed indicator species have been subject to an IUCN assessment and in general, vulnerability relates to species being slow-growing and susceptible to physical disturbance. These taxa are therefore taken to represent a wider ecosystem deemed to be vulnerable to the effects of bottom

[90] NAFO SC Reports: https://www.nafo.int/Library/Publications/SC-Reports
[91] History of WGMSE for Greenland Halibut: https://www.nafo.int/Science/NAFO-Frameworks/MSE
[92] NAFO VME Indicator Species List: https://www.nafo.int/Library/Documents-chronological/nafo-sc-studies-no-47-2015

contacting activities, rather than the individual species being at risk (e.g. *Lophelia pertusa* is widely distributed in the North Atlantic and, although it is slow-growing and fragile, is unlikely to be at risk of a population collapse).

Table A1.4.2 – VME Indicator taxa with example species (full list in Kenchington *et al.*, 2015). IUCN Status (all species) = Not Evaluated. Other taxa include actinarians (anemones), crinoids and ascidaceans.

Coarse Taxa	Example Species	Habitat Information
Alcyonacea	*Anthomastus* spp.	Hard or soft substratum. 170 – 1400 m
	Gersemina rubiformis	Hard or soft substratum. 35 – 700 m
	Paragorgia arborea	Hard substratum. 200 – 4100 m. Larger individuals tend to be > 800 m.
Antipatharia	*Stauropathes arctica*	Hard substratum. 700 – 1850 m
Pennatulacea	*Anthoptilum grandiflorum*	Soft substratum. 150 – 2400 m
	Umbellula spp.	Soft substratum. 200 – 2600 m
Scleractinia	*Lophelia pertusa*	Hard substratum. 200 – 1000 m
	Desmophyllum dianthus	Hard substratum. 700 – 1400 m
Demospongiae	*Cladorhiza* spp.	Soft substratum
	Geodia spp.	Hard or gravel substrata.
	Spongionella pulchella	Hard or gravel substrata.
Hexactinellida	*Asconema foliata*	Hard or gravel substrata.
	Chonelasma choanoides	Hard or gravel substrata.

The VME habitat types are delineated by their major invertebrate constituents (sponge, coral and sea pens) and their geologic setting (continental margin or seamount). The present closure network is based upon data which estimates the distribution of the key invertebrate taxa and doesn't explicitly cover topographic or other spatial factors that would relate to finer scale compositional variation (i.e. several of the closures will include a diverse array of ecotypes, some of which may not be exposed to fishing impacts). The seamount closures are a large proportion (90 %) of the total closed area, but fall outside of the defined fishing footprint in the NRA and so, irrespective of their protected status, could only be subject to exploratory fisheries, which requires explicit approval of the Commission. The vast majority of the fishing activity in the Convention area occurs within the Canadian EEZ (Fuller *et al.*, 2008) and so, although the SC may be asked to render stock advice, national programmes for networks of MPAs take precedence (e.g. Westhead *et al.*, 2012). It is unclear to what extent the NAFO and Canadian national closed area networks are complementary and at what level strategic decisions are made.

There is limited information regarding the importance of the VME for commercially important species. The working assumption is, not unreasonably, that these reef-forming species provide a mechanism for micro-scale habitat generation and consequently, promote the amount of available essential fish habitat. However, there has not been an empirical demonstration that this is the case within the NRA. This could be considered an important step in the evaluation of the success of the present closed area network. A review of the functional significance of different VME types is currently underway (WG-EAFFM, 2017).

A1.4.4. Assessment of impacts upon sensitive species and habitats

There have been several independent surveys of VMEs conducted in the fishing footprint (Murillo *et al.*, 2012; Knudby *et al.*, 2013a; Barrio-Froján *et al.*, 2016), but these generally appear to have been *ad hoc* and, although they generally use similar approaches (dedicated sampling together with spatial modelling of occurrence and environmental parameters), there is little evidence amongst the published literature that methods are standardised. Reports are published either through the NAFO website, as technical reports, or through more standard academic channels. The FC, though the VME working group (WG-FMS-VME) resolved in 2011 to initiate a five-yearly cycle for reassessment of fishing impacts of 'known or likely vulnerable marine ecosystems' (NAFO FC, 2011), the first iteration of which was conducted in 2016. These periodic assessments include advice from the SC on the extent of significant adverse impacts (SAI).

Vessels fishing within the NRA are however subject to full observer coverage, who are able to record incidences of VME indicator species caught during commercial operations. Given the available sources of information, and the relatively small area of the NRA fishing footprint, it is probably reasonable to assert that the distribution of the key VME indicator taxa is relatively well understood. Consequently, the lack of routine surveys with standardised methods for assessing the status of VMEs is not necessarily a cause for concern, though the proportion of the fishing footprint that is protected from bottom gears (7.0 %) may be argued to be relatively small. However, the area of VME protected within the footprint is supplemented by closures in non-fishing areas (outside of the footprint), which will likely enhance and support the functioning of VMEs within the footprint, through larval production and dispersal.

The assessment of Significant Adverse Impacts (SAIs) has been part of the organisation's strategy following an agreement at the 2005 annual meeting, and the subsequent adoption of interim measures in 2007 (NAFO FC, 2007). This was part of a modernisation programme aimed at bringing NAFO measures into line with pertinent international legislation (in particular, UN General Assembly resolution 59/25[93]) and more explicitly to adopt an ecosystem approach to fisheries, including precautionary approach principles[94].

Conservation and Enforcement Measures (CEMs) are reviewed and published annually[95], with each iteration reflecting the most recent decisions made by the Commission at its annual meeting. Amendments from the previous versions are detailed in each iteration, together with reference to the specific report where the justification for the new recommendations may be found. These reports are generally produced by particular working groups, following a request for advice by the Commission or a Contracting Party. The CEM handbook is a full list of the technical standards expected of fishing vessels, including both long standing measures like reporting standards, as well as regularly reviewed measures relating to specific stocks or gear types (e.g. quota allocations, minimum landing sizes, minimum fishing depths).

A1.4.5. Mapping of sensitive species and habitats

Funding for scientific/ fishery-independent surveys has historically come from a range of sources including *ad hoc* funded scientific investigations and the annual programme of fishery independent surveys which record all catch data including invertebrate by-catch. Two of the more recent dedicated VME surveys have been funded by the Spanish Government (Murillo *et al.*, 2012) and the European Commission (Barrio-Froján *et al.*, 2016). Funding for other surveys (e.g. Fuller *et al.*, 2008) is less clearly outlined. These surveys have focussed upon the NRA fishing footprint, but further information is available from vessel reports, fisheries surveys (e.g. the DFO trawl survey database) and the observer programme from the Convention area, almost all of which falls within the Canadian EEZ (Fuller *et al.*, 2008).

Observers are mandatory for every vessel whilst it is fishing within the NRA, the costs of which are met by individual Contracting Parties (though a small proportion of the Organisation's budget is also allocated to the Fishery Monitoring programme (ca. 2 % in 2016). Observers are primarily tasked with ensuring that vessels comply fully with the current set of CEMs, as well as making detailed records of the vessel's activities and catch that can subsequently be compared with vessel reports (NAFO CEM, 2018).

Several species distribution/ habitat suitability models have been developed for the different VME indicator taxa in the NRA. Several VME indicator taxa are distributed widely, both within the

[93] http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/59/25

[94] The precautionary approach was initially adopted with respect to resource assessment (NAFO FC, 2004) but has, under the auspices of WG-RBMS, begun to be rolled out across the organisation.

[95] NAFO CEM archive: https://www.nafo.int/Fisheries/Conservation

Convention area and, more specifically, the NRA fishing footprint (Fuller *et al.*, 2008; Knudby *et al.*, 2013a). Corals seem to be most commonly associated with sloping areas around the Flemish cap and along the Grand banks margin (Knudby *et al.*, 2013a), but seapen and sponge grounds can also occur in areas of relatively shallow slope, in the Flemish Pass and on the Grand Banks (Knudby *et al.*, 2013b; Barrio-Froján *et al.*, 2016). Typical environmental parameters used in the prediction of habitat suitability in the NRA include:

- Surface biophysical characteristics (salinity, current, productivity…)
- Bottom physical characteristics (temperature, shear stress/ current speed…)
- Topography (depth, slope…)

Since HSM approaches are more suited to estimating the distribution of groups of species with similar environmental preferences, there has not been an assessment of the extent of all VMEs throughout the fishing footprint. It is not clear precisely how the current set of area closures were delineated and how the areas have been split between sponge, coral and seapen grounds, but there is qualitatively clear overlap between these and a number of the VME indicator hotspots identified for corals and seapen by Knudby *et al.* (2013a), and sponges by Kenchington *et al.*, (2014). The VME encounter rules detailed in the CEMs also provide a route towards establishing a new area closure so these data may have also contributed to the present regime[96]. A possible reason for areas projected to have high suitability not being included in the current closed area network is that these are areas that formerly had high biomass of VME indicator species but, over the history of fishing in the area, currently host only a small proportion of their virgin indicator species biomass.

A1.4.6. Impact mitigation and protection

The NAFO convention area covers 6,551,000 km^2, of which 2,708,000 km^2 comprises the NAFO Regulatory Area. The NRA is the part of the Convention Area which is beyond national jurisdiction west of 43°00 W and north of 35°00 N. The NAFO convention area shares its eastern border with the NEAFC Convention Area in the mid-Atlantic and, to the south, with the WECAFC Convention Area. There are currently no plans to change the convention area. The convention area is comprised of 36 sub-divisions, but the fishing effort within the NRA is confined to 3L, 3M, 3N and 3O (Grand Banks, Flemish Pass & Flemish Cap). The fishing footprint (120,048 km^2) is outlined in the CEM (CEM Art. 16), but the Commission and CPs are able to propose revisions to the footprint at any point, based upon the distribution of haul by haul catch data.

Data on the distribution of catch and effort are not publicly available, but VME indicator taxa are distributed widely throughout the fishing footprint (Fuller *et al.*, 2008; Murillo *et al.*, 2012; Knudby *et al.*, 2013a), suggesting that a high proportion of the fishing effort within the NRA occurs in areas that are known to host VMEs or are at least offer potentially suitable habitat for VME indicator species.

Articles 15 and 22 of the CEMs detail the VME encounter rules. An 'encounter' is defined as a catch per set where by-catch of any species listed in the VME indicator species guide exceeds an agreed threshold: i. sea pens – 7 kg, ii. live coral – 60 kg, and iii. Sponges – 300 kg.

Following an encounter, vessels, supported by scientific observers, are required to:

i. Identify and quantify the catch of VME indicator species;
ii. Report the encounter to the flag state, including the best available information on the position of the encounter;
    - The flag state must report the encounter to the Secretariat and alert its vessels as appropriate.

[96] In fact, this is expected and if the present network of closures is not corroborated by historic records of encounters, it would suggest that the distribution models are not performing well.

iii. Cease fishing and move at least 2 nautical miles from the reported position in the direction 'least likely to result in further encounters'.

The executive secretary, upon receiving the information from the flag state, is required to:

i. Archive the report and alert other CPs;
ii. Request that the CPs establish a temporary closure (2 nm radius around reported position). This temporary closure remains in effect until the SC is able to reach a conclusion on whether the encounter is indicative of a VME and the Commission has been able to implement an amendment to the CEMs if appropriate;
iii. Summarise the reports for its annual report to the SC.

It is not clear how often the VME encounter thresholds are met, or how regularly an encounter results in a new area closure being more permanently established. The entire closed area network is subject to a 5-yearly review cycle (CEM Art. 23.2a) by the Commission, the SC and WG-EAFFM. The next review is scheduled for 2020 (CEM, 2018) with a full re-assessment of bottom fisheries and SAI occurring in 2021.

Contracting parties wishing to engage in exploratory bottom fishing activities are required, under CEM Art. 18, to:

i. Notify, and await authorisation from, the executive secretary and provide an assessment (CEM Annex 1.E);
ii. Have on board a sufficiently trained observer for the full duration of the trip;
iii. Provide an 'Exploratory Bottom Fishing Trip Report' (CEM Annex 1.E), within 3 months of the completion of exploratory fishing activities. This report is circulated to all CPs.

A1.4.7. Monitoring of VME impacts

The evidence for the distribution of VMEs is reviewed on a five-yearly[97] cycle by the Commission and the SC that takes into account the most recent scientific information to evaluate the efficacy of the current regime and promote improvements where possible (CEM Article 23). There are no stipulations with respect to how these data must be sourced and the organisation, or any of its CPs, are not required to directly fund surveys of VME and, judging by the funding sources utilised by previous surveys, it seems likely that dedicated sampling opportunities are subject to external funding being awarded. Surveys have historically been staffed by members of the SC and/ or specific WGs.

The principal means by which VMEs are monitored, at least in terms of sampling effort, appears to be from fishery stock surveys and vessel/observer reports, both in the NRA and in the EEZs of the coastal states. There is a large historic dataset of VME indicator species records (Fuller *et al.*, 2008), suggesting that the estimation of the distribution of VMEs in the Convention area is well enumerated and, on the whole, quite mature relative to younger or more data-poor organisations like SIOFA. Consequently, the network of closed areas is likely stable and there may not be a need for a more regular cycle of review and reassessment.

[97] Or in the case of new evidence of VMEs or a significant change to fishing activity.

A1.5. NEAFC

A1.5.1. Organisation, Data and Governance

The North East Atlantic Fisheries Commission (NEAFC) is the competent organisation promoting the rational exploitation of fisheries within the Regulatory Areas (RA) of the Convention Area. It covers the Atlantic and Arctic Oceans east of Cape Farewell (Greenland, 42° W), North of 36° N and West of 51°E, excluding the Baltic and Mediterranean Seas. The RA includes all international waters within the Convention Area.

NEAFC was originally founded in 1959 by 14 countries, but a new Convention was signed in 1980, which entered into force in 1982, aiming to ensure "the long-term conservation and optimum utilisation of the fishery resources in the Convention Area, providing sustainable economic, environmental and social benefits".

Current Contracting Parties (CPs) are Denmark in respect of the Faroe Islands and Greenland, EU, Iceland, Norway and the Russian Federation. Additionally, the Bahamas, Canada, Liberia, New Zealand and St Kitts & Nevis are Cooperating non-CP. All CP are coastal states or have a fishing history in the area. Becoming a new Contracting Party depends on finding new fisheries since stocks regulated by NEAFC are fully allocated.

The total area of NEAFC RA (waters beyond EEZs and excluding Central Arctic area) is about 5,300,000 km^2 (NEAFC, 2012a).

The RA comprises four separate areas (Fig. A1.5.2), but the Arctic area is almost permanently ice-covered, and there are no fisheries there. Fisheries are therefore regulated in RA1, Reykjanes Ridge, between Iceland and the Azores; RA2, Banana Hole, in the Norwegian Sea; RA3, Loophole in the Barents Sea.

The NEAFC RA is quite stable, although the Loophole boundaries were recently updated according to the 2010 Norway – Russia Marine Boundary Agreement.

The head of the Commission is the President, who is responsible for convening, presiding, opening and closing and running regular meetings of the Contracting Parties and ensuring that the business of the Commission is carried out effectively and in accordance with its decisions. Presidents are elected from among the Contracting Parties for three years. A President may serve more than once, but not more than two consecutive terms. The current President is Jacques Verborgh, EU.

The Committees are:

- Permanent Committee on Monitoring and Compliance (PECMAC), meets 2-3 times a year. Includes representatives from all the CP. It is responsible for producing advice on fishing controls and the enforcement of the Scheme of Control and Enforcement (SCE);
- Permanent Committee on Management and Science (PECMAS), meets once a year. It drafts responses to requests for advice, reviews proposals for management measures (i.e. closures) and exploratory fishing submitted by CP, it supports and exchanges information with ICES;
- Finance and Administration Committee (FAC), responsible for the annual budget and administrative matters, with all CP represented.

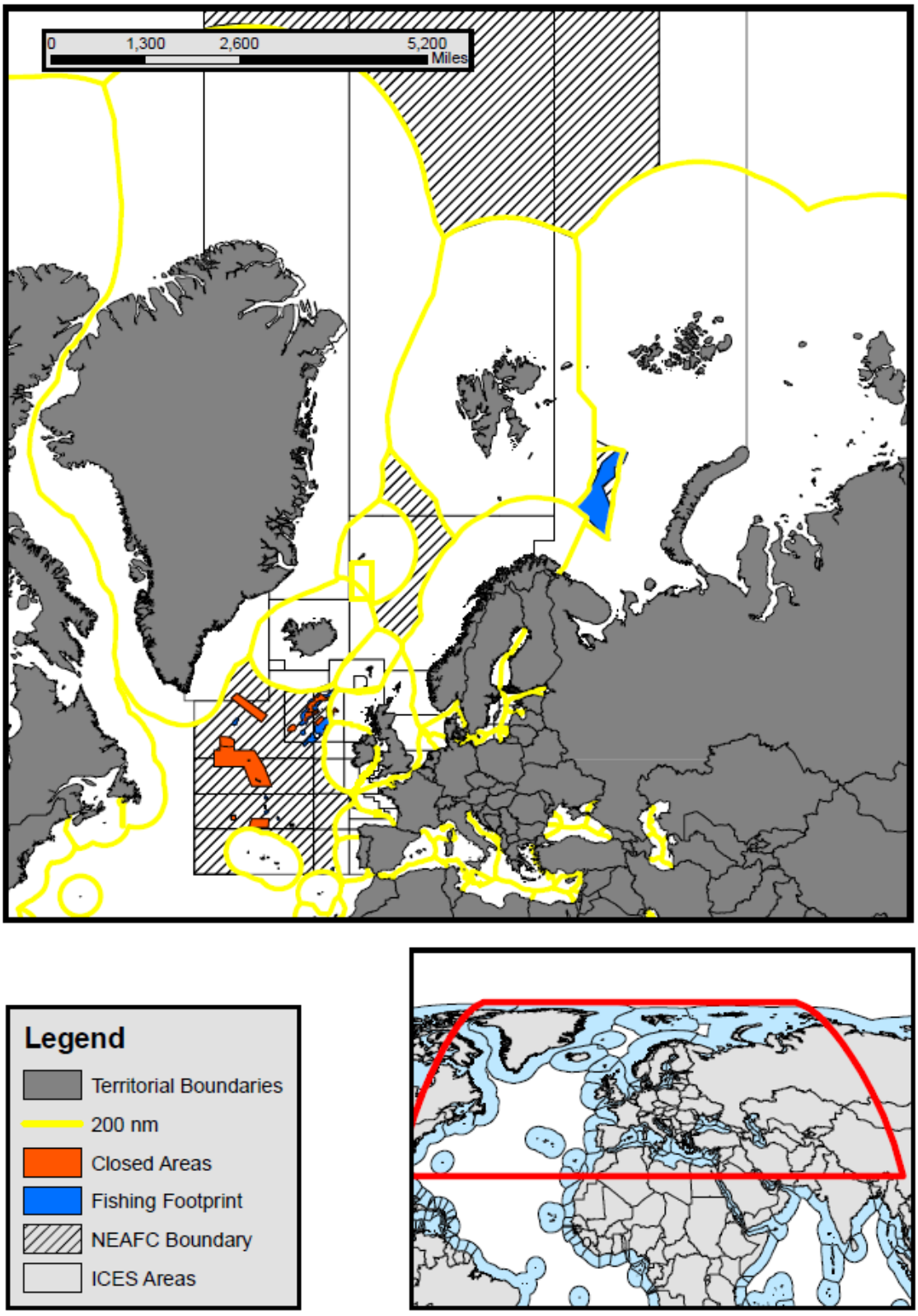

Figure A1.5.1 – Map of the NEAFC RA. Red area on bottom-right panel indicates extent of top panel.

NEAFC has a Secretariat based in London, three Permanent Committees and a variable number of Working Groups. The Secretariat was established in 1999 and has 6 staff members; the Secretary (4 years appointment), three Officers (Monitoring Control and Surveillance, Information Technology and Web Production, and IT & Systems Developer); an Administrative Assistant and a Finance and Administration Assistant.

The Working Groups (WG) include representatives from the CP to provide advice based on very detailed information concerning specific issues and areas. They are formed at the request of the Commission and exist for as long as they are needed. Reports of the different WGs are presented as advice to the Commission during the Annual Meeting of NEAFC. The current Working Groups[98] are:

a) Joint Advisory Group on Data Management (JAGDM) which was established jointly by NEAFC and NAFO to harmonise data collection between both RFMOs and offer technical advice to Contracting Parties and other RFMOs if requested. It meets once or twice a year;
b) WG on Statistics (WGStats). Responsible for permanent availability of the most complete and "real time" statistics on fishing activities and quota uptake in the RA and CA.
c) WG on the Future of NEAFC (WGFN), to strengthen NEAFC, identify future challenges and ensure that the objectives can be fulfilled.
d) WG on Allocation Criteria (WG Allocation). All CP are represented. It defines, analyses and recommends the criteria for quota allocations on discrete and straddling stocks occurring in waters of the Coastal States and the RA.
e) WG on the Framework for Coastal State Negotiations (WG Framework). All CP are represented. It provides a framework for Coastal State negotiations on straddling pelagic fish stocks and straddling redfish stocks in the CA.

The NEAFC budget is not public, but a call to fill a vacancy in 2016 mentions an annual budget of £1.5 million (ca. €1.7 million). Contributions from the different CPs depend on their nominal catches in the CA and their population[99].

NEAFC has two bilateral Memorandums of Understanding, with ICES (NEAFC, 2007) and OSPAR.

The NEAFC Scheme of Control and Enforcement[100] (SCE) is amended and updated at the Annual Meeting. It consists of 46 articles under seven chapters and several Annexes and Appendices with technical specifications. There is no published information on the performance of the CPs.

CPs are responsible for identification and catch reports of their vessels. The catch on board must be reported to the Fisheries Monitoring Centres (FMC) of the relevant CP between 12 and 2 hours prior to entering the RA. Once there, they must report daily[101] catches aggregated by species; as well as number of fishing days and total catch within the RA between 8 to 2 hours before leaving the RA.

Management measures (MM) are decided at the Annual Meeting by the Parties in the Commission on the basis of scientific advice from the International Council for the Exploration of the Sea (ICES). Decisions can also be taken by postal vote throughout the year if needed. Currently there are 37 management measures in force, directed to specific stocks, species, fisheries and VMEs. Management measures enter into force 30 days after becoming binding, but are not binding for CPs which object. CPs are responsible for sanctioning their own vessels. Each CP updates annually the list of vessels for which a surveillance report has been filed and the status of their case. Penalties include fines and forfeited fish or gear.

Regarding conservation measures, there is a seasonal closure to protect spawning aggregations of blue ling, and 19 other year-round closures for the protection of VMEs, in different areas of the Middle Atlantic Ridge, Altair and Anti-altair Seamounts, Hatton, Edora and Rockall Banks, Hatton-Rockall Basin and Logachev and W Rockall Mounds. All of them are periodically reviewed.

[98] This list is not exhaustive and includes only the WG listed in NEAFC website at the time of writing this report.
[99] Text of NEAFC Convention: https://www.neafc.org/system/files/Text-of-NEAFC-Convention-04.pdf
[100] NEAFC Scheme of Control and Enforcement: https://www.neafc.org/scheme/contents
[101] EU objected to this and remains bound to previous version, which requires weekly submission of catch information: https://www.neafc.org/scheme/Chapter3/article12

All fishing vessels of CPs must keep a logbook as specified in the SCE, and report to the Secretary provisional monthly statistics of catches of regulated resources. None of this information is publicly available.

CPs must ensure that catch of VME indicators is quantified. If it exceeds the defined thresholds, there is a move-on rule and obligation of the skipper to report the encounter. The Secretary must inform all CPs and ICES[102]. A temporary closure can be made effective until the existence of a VME is confirmed.

The threshold levels to define an encounter with a possible VME are >30 kg of live coral and/ or >400 kg of live sponges in a single haul for towed fishing gear other than longlines; or 10 hooks per 1000 hook segment or per 1200m of line, whichever is sorter, for longline sets. ICES provide a template for submission of VME data.

Monitoring Control and Surveillance (MCS) procedures are also described in the SCE. Vessels >20m must be equipped with a Vessel Monitoring System (VMS). These data are transferred twice a year from the NEAFC Secretariat to ICES.

Vessels infringing the management measures and the SCE are considered to be undertaking IUU fishing and are listed accordingly. Non-Contracting Party fishing vessels identified as engaging in IUU fishing activities in the Convention Area are immediately put on the A-List (provisional list). If explanations by the flag state are not satisfactory, the vessel is put on the B-list (vessel confirmed involved in IUU activities).

Vessels in the A-List cannot land or tranship, do not have access to supplies and are thoroughly inspected. Vessels in the B-List cannot enter port or fish in EEZ of CP. Currently there are no vessels in the A-List and there are 8 vessels in the B-List.

The number of reports by WG and ad-hoc WG ranges from 1 to 11 per year during the period 2013-2017. The WG reports are online, but lack technical details, data and graphs.

A1.5.2. Fishing activities controlled by the organisation

NEAFC does not provide information on the distribution of fishing effort. However, logbook data used for scientific advice show catches within a range of average depth per species of 400 – 1300m.

The NEAFC website lists as main fisheries redfish (both oceanic and pelagic deep-sea *Sebastes mentella,* REB), mackerel (*Scomber scombrus*, MAC), haddock (*Melanogrammus aeglefinus*, HAD), herring (Norwegian spring – spawning & Atlanto-Scandian, *Cuplea harengus*, HER), Blue whiting (*Micromesistious poutassou*, WHB) and deep-sea species. Deep-sea fishing includes all fishing at depth >400m. Catches of deep-sea species (as defined in Annex I of EU Regulation 2016/2336) include 41 species of which argentines (Argentina spp, ARG), Greenland halibut (*Reinhardtius hippoglossoides*, GHL), ling (*Molva molva*, LIN) and tusk (*Brosmio brosmio*, USK) comprise on average 80% of the total annual catch for the period 2013-2015[103].

Since all main target species except for haddock are pelagic and pelagic catches are clean, we can consider as bycatch all deep-sea species caught with otter bottom trawl in proportion >10% of total deep-sea catch per year.

[102] NEAF Rec. 19-2014: http://neafc.org/system/files/Rec.19-2014_as_amended_by_09_2015_and_10_2018_fulltext-and-map.pdf
[103] ICES. 2017. Report of the Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP), 24 April–1 May 2017, Copenhagen, Denmark. ICES CM 2017/ACOM:14.

Table A1.5.1 – Stocks assessed by NEAFC

Target Species	FAO code	Management Areas	Assessed Stocks	Typical Assessment
Redfish (*Sebastes mentella*)	SEB	1,2 5,6,12, 14 NAFO 1+2	1,2 14,5a (Icelandic slope) 14b SE Greenland 5a,12, 14, NAFO 1+2 <500m Shallow 5a,12, 14, NAFO 1+2 >500m Deep	1 1 1 1 1
Mackerel (*Scomber scombrus*)	MAC	1-8, 9a, 14	1-8, 9a, 14	1
Haddock (*Melanogrammus aeglefinus*)	HAD	1,2,3,4,5,6,7,20	1,2 (NE Arctic) 5a (Iceland) 5b (Faroes) 6b (Rockall) 7a (Irish Sea) 4, 6a,20 (North Sea, W Scotland, Skarregak) 7b-7k (S Celtic Seas & English Channel) 7bc,7e-k (Celtic Sea) 4,7d,3a20 (North Sea, E English Channel, Skarregak)	1 1 1 1 1 1 1 1 1
Herring (*Clupea harengus*)	HER	1,2,5, 4a,14a	1,2,5,4a,14a	1
Blue whiting (*Micromesistius poutassou*)	BHW	1-9, 12,14	1-9, 12,14	1
Argentines (*Argentina* spp)	ARG	NA	NA	NA
Greenland halibut (*Rheinhardtius hippoglossoides*)	GHL	1,2,5,6,12,14	1,2 5,6,12,14	1 1
Ling (*Molva molva*)	LIN	1 - 14	1,2 5a 5b 6-9,12,14,3a,4a	2 2 2 2
Tusk (*Brosme brosme*)	USK	1-9, 12,14	6B (Rockall) 12 excl 12.b (S MAR) 14, 5A (E Greenland, Iceland) 1,2 (NE Arctic) 4,7-9,3a,5b,6a,12b	2 2 1 2 2
Bycatch species				
Alfonsinos (*Beryx* spp.)	ALF	NE Atlantic	NE Atlantic	2
Arctic skate (*Raja hyperborea*)	RJG	4-14	NA	NA
Baird's smooth head (*Alepocehalus bairdii*)	ALC	NA	NA	NA
Birdbeak dogfish (*Deania calcea*)	DCA	NA	NA	NA
Black (Deep-water) cardinal fish (*Epigonus telescopus*)	EPI	NA	NA	NA

Black dogfish (*Centroscyllium fabricii*)	CFB	NA	NA	NA
Black scabbard fish (*Aphanopus carbo*)	BSF	1, 2, 4, 6–8, 10, 14, 3.a, 5.a–b, 9.a, and 12.b	1, 2, 4, 6–8, 10, 14, 3.a, 5.a–b, 9.a, and 12.b (NE Atlantic)	2
Blackmouth dogfish (*Galeus melastomus*)	SHO	6,7,8,9	6,7 8,9a	2 2
Blue ling *(Molva dypterigia*)	BLI	1,2,3,5,6,7,8,9,12,14	14, 5a (E Greenland, Iceland) 1,2,8,9,21,3a,4a (other areas) 6,7,5b (Celtic Seas, English Channel, Faroes ground)	1 2 2
Bluemouth (Blue mouth redfish) (*Helicolenus dactylopterus*)	BRF	NA	NA	NA
Bluntnose six-gilled shark (*Hexanchus griseus*)	SBL	NA	NA	NA
Common mora (*Mora moro*)	RIB	NA	NA	NA
Conger eel (*Conger conger*)	COE	NA	NA	NA
Deep-water red crab (*Chaceon affinis*)	KEF	NA	NA	NA
Eelpout (*Zoarces viviparus*)	ELP	NA	NA	NA
Forkbeards (*Phycis* spp.)	FOX	NA	NA	NA
Greater argentine (*Argentina silus*)	ARU	1-10,12	1,2,3a,4 (NE Arctic, North Sea, Skagerrak and Kattegat) 5a,14 (E Greenland, Iceland) 5b,6a (Faroes, W Scotland) 6b,7-10,12 (other areas)	2 1 2 2
Greater forkbeard (*Phycis blennoides*)	GFB	I-10, 12, 14	I-10, 12, 14 (NE Atlantic, adjacent waters)	2
Greenland shark (*Somniosus microcephalus*)	GSK	4-14	NA	NA
Gulper shark (*Centrophorus granulosus*)	GUP	4-14	NA	NA
Kitefin shark (*Dalatias licha*)	SCK	NE Atlantic	NE Atlantic	4
Knifetooth dogfish (*Scymnodon ringens*)	SYR	4-14	NA	NA
Lantern sharks (*Etmopterus* spp.)	SHL	4-14	NA	NA
Leafscale gulper shark (*Centrophorus squamosus*)	GUQ	NE Atlantic	NE Atlantic	4
Longnose velvet dogfish	CYP	4-14	NA	NA

(*Centroscymnus crepidater*)				
Mouse catshark (*Galeus murinus*)	GAM	4-14	NA	NA
Orange roughy (*Hoplostethus atlanticus*)	ORY	NE Atlantic	NE Atlantic	4
Portuguese dogfish (*Centroscymnus coelolepis*)	CYO	NE Atlantic	NE Atlantic	4
Rabbit fish (*Chimaera monstrosa*)	CMO	4-14	NA	NA
Red (blackspot) seabream (*Pagellus bogaraveo*)	SBR	6-10	10 (Azores) 6-8 (Celtic Seas, English Channel, Bay of Biscay) 9 (Atlantic Iberian)	1 2 2
Risso's smooth head (*Alepocephalus rostratus*)	PHO	NA	NA	NA
Roughhead grenadier (Rough rattail) (*Macrourus berglax*)	RHG	5-8,10,12,14	5-8,10,12,14 (NE Atlantic, Arctic Ocean)	5
Roundnose grenadier (*Coryphaenoides rupestris*)	RNG	1-10,12,14	1,2,4,5a,8,9,14ab (NE Atlantic, Arctic Ocean) 3a (Skarregak, Skattegat) 5a,10b,12c,12a1,14b1,5a1 (Oceanic NE Atlantic, N Reykjanes ridge) 5b,6,7,12b (Celtic Seas, English Channel, Faroes, W Hatton Bank)	2 2 2 2
Silver roughy (Pink) (*Hoplostethus mediterraneus*)	HPR	NA	NA	NA
Silver scabbard fish (*Lepidopus caudatus*)	SFS	NA	NA	NA
Small redfish (*Sebastes viviparus*)	SFV	5a	NA	NA
Spiny (Deep-sea) Scorpionfish (*Trachyscorpia cristulata*)	TJX	NA	NA	NA
Wreckfish (*Polyprion americanus*)	WRF	NA	NA	NA

Many of the caught species are assessed by different ICES WG (WGDEEP, NWWG, WGWIDE, AFWG, WGEF) and advice is released periodically (Table A1.5.1). There are 53 assessed stocks belonging to 21 species, and a further 26 species with small catches for which there is no formal advice, although the pertinent information is collected and published in the corresponding ICES WG reports. The assessment frequency varies between 1 to 5 yearly intervals, but 60% of the assessed stocks have annual or biennial assessments. Age-structured assessments are conducted for 16 stocks, survey trends-based assessments for 12 stocks and CPUE trends-based assessments for 10 stocks.

Quota allocations are made by the EU (based on scientific advice) and non-EU NEAFC CP. NEAFC publishes recommendations for the Coastal States or the CPs to follow the ICES scientific advice for all target species and deep-sea species. Only in the case of redfish fisheries in the Irminger Sea does NEAFC allocate the advised maximum catch among CPs, but this allocation is neither binding or agreed upon.

Independently of the standard ICES Advice, NEAFC can request to ICES special advice on different issues (management strategies, fisheries closures, etc.), that is published in ICES annual Advice Reports. No management strategy evaluations are carried out in NEAFC.

The Marine Conservation Institute (2015) estimates that the "fishable area" represents 37% of NEAFC RA, of which nearly 9% is associated with seamounts[104].

Total catch over the period 2013-2015 has ranged from 2.96 to 3.95 mill t, of which 92.4 to 94.4% are caught with midwater otter trawl. There is no readily available aggregated information on fleet size, fishing effort, catch value or exports outside the RFMO.

A1.5.3. Description of Sensitive Species and Habitats

OSPAR is developing biodiversity indicators such as Benthic Habitat Indicator 3 (BH3): Physical damage of predominant and special habitats. The main focus is on predominant habitats and those in the OSPAR list of declining habitats: coral gardens, deep-sea sponge aggregations, Lophelia reefs, oceanic ridges, seamounts, sea pen and burrowing megafauna communities.

ICES is the Scientific advisory body of NEAFC (NEAFC, 2017). The data on distribution of sensitive species/habitats in the NEAFC RA are in the ICES VME Database (http://www.ices.dk/marine-data/data-portals). The records have different sources (e.g. deep-sea research surveys, by-catch, ROV, etc.) and are submitted by ICES member countries. The database includes habitat records, for which there is unequivocal evidence for a VME (e.g. a ROV video transect showing a cold-water coral reef) and indicator records (e.g. by-catch record), which suggest the presence of a VME with varying degrees of uncertainty. For VME indicators a weighting system of vulnerability and uncertainty is provided as part of the database to aid interpretation. Thus, knowledge on distribution of biodiversity indicators and vulnerable species and habitats is patchy due to variable quality of available data and data gaps.

According to NEAFC Recommendation 19:2014 (Article 2g), 'VME' is equivalent to the definitions provided in paragraphs 42 and 43 of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas.

In the current NEAFC list of VME indicator species and taxa, representative taxa were assigned to VME habitat types and physical elements. There are seven habitat types and five physical elements (VME indicator geomorphological features) for the NEAFC RA. The taxa most likely to be found in these habitats and elements are listed in Annex 5 of amended Recommendation 19:2014 (NEAFC, 2018). All these are considered as VME indicator species (Table A1.5.2; Table A1.5.3).

Table A1.5.2 – VME indicator species recognised by NEAFC. IUCN status of all species = Not Assessed. *Included in OSPAR list of threatened/ declining species and habitats[105]

#	VME Habitat Type	Representative Taxa
1	Cold-Water Coral Reef	

[104] https://marine-conservation.org/media/filer_public/filer_public/2015/09/01/neafc.jpg
[105] https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats

1a	*Lophelia* reefs*	*Lophelia pertusa*
1b	*Solenosmilia* reefs	*Solenosmilia variabilis*
2	Coral Gardens*	
2a	Hard bottom garden	
2a1	Hard bottom gorgonian and black coral gardens	Anthothelidae
		Chrysogorgiidae
		Isididae
		Keratoisidinae
		Acanthogorgiidae
		Corallidae
		Paragorgidae
		Primnoidae
2a2	Colonial scleractinians on rocky outcrops	*Lophelia pertusa*
		Solenosmilia variabilis
2a3	Non-reef scleractinian aggregations	*Enallopsammia rostrate*
		Madrepora oculate
2b	Soft-bottom coral gardens	
2b1	Soft-bottom gorgonian and black coral gardens	Chrysogorgiidae
2b2	Cup coral fields	Caryophyllidae
		Flabellidae
2b3	Cauliflower coral fields	Nephtheidae
3	Deep-sea Sponge aggregations*	
3a	Other	Geodiidae
		Ancorinidae
		Pachastrellidae
3b	Hard-bottom sponge gardens	Axinellidae
		Mycalidae
		Polymastiidae
3c	Glass sponge communities	Rossellidae
		Pheronematidae
4	Seapen fields*	Anthoptildae
		Pennatulidae
		Funiculinidae
		Halipteridae
		Kophobelemnidae
		Protoptilidae
		Umbellulidae
		Vigulgriidae
5	Tube-dwelling anemone patches	Cerianthidae
6	Mud and sand emergent fauna	Bourgueticrinidae
		Antedonidae
		Hyocrinidae
		Xenophyophora
		Syringamminidae
7	Bryozoan patches	

The list of NEAFC deep-sea fish species (NEAFC, 2016) includes 25 bony fishes and 23 cartilaginous fishes. Some of these are closely associated with VME. According to FAO (2009) deep-sea fish species have unique biological characteristics, such as: late maturation; slow growth; long life; low natural mortality rates; intermittent recruitment of successful year classes; and spawning may not be annual. This makes many deep-sea resources very sensitive to exploitation. The list of NEAFC invertebrates associated with VMEs includes cold water corals, deep-sea sponges, cerianthids, crinoids and xenophyophores. Cold water corals and sponges have structural characteristics and they are fragile,

slow-growing and long-lived (Stone & Wing, 2001; Gass & Roberts, 2006; Roberts *et al.*, 2009; Risk *et al.*, 2002; Andrews *et al.*, 2002, 2005; 2009; Freiwald et al, 2004; Schöeder-Ritzrau, 2005; Roark *et al.*, 2009, Hoppe 1988; Leys & Lauzon 1998; Gatti 2002; Klitgaard & Tendal 2004). Sea pens appear to be more resilient than other VME indicator species (NAFO, 2017). Crinoids present aggregation behaviour and are especially sensitive to fishing impacts due to their fragility. Available information on their longevity, which exceeds 20 years for certain species, and data on growth rates are scarce (Roux, 1976; Messing *et al.*, 2007). Most bryozoans are short-lived and some of them have structural characteristics. Although studies of growth and age are few, some colonies of large erect bryozoans can reach 20 years old (Smith *et al.*, 2001). Little is known about the biology of the deep-water cerianthid species, but lifespan of one species has been reported as 11-20 years (Manuel, 1988). Very little is known of the life history of Xenophyophores, a group of fragile deep-sea foraminifera, but limited evidence suggests growth could be relatively fast (Gooday *et al.*, 1993).

The dominant VME habitat types in the NEAFC RA are cold water coral reefs; coral gardens and deep-sea sponge aggregations (ICES, 2013a), which occur across a depth range of 450-2000 m (CBD, 2012). The dominant physical elements are seamounts, steep-slopes and peaks, canyons and steep flanks and knolls.

Table A1.5.3 – VME habitats recognised by NEAFC. *Included in OSPAR list of threatened/ declining species and habitats.

PHYSICAL ELEMENTS (VME INDICATOR FEATURES)	EXPLANATION
Isolated seamounts*	Non-MAR seamounts
Steep-slopes and peaks on mid-ocean ridges	Steep ridges and peaks support coral gardens and other VME species in high density.
Knolls	A topographic feature that rises less than 1,000 metres from the seafloor.
Canyon-like features	A steep sided “catchment” feature not necessarily associated with a shelf, island or bank margin
Steep flanks >6.4°	Submerged edges and slopes are recognized geological features that potentially support vulnerable species groups or communities such as corals and sponges (Murillo *et al.*, 2011).

Several geomorphological features with VME elements in the NEAFC RA at fishable depths <2,000 m have been mapped (ICES, 2013a). VME elements present include pinnacles, knolls, seamounts, ridges, steep flanks and slopes, canyon-like features and vent sites.

A1.5.4. Assessment of impacts upon sensitive species and habitats

There have been several scientific cruises and *ad hoc* surveys carried out by ICES member countries in the NE Atlantic, some of which provide information for assessing deep-water resources and VMEs in the NEAFC RA. These results together with fishery independent survey catch data form the basis for implementing fisheries closures (Durán Muñoz *et al.*, 2012a).

Observer schemes are only mandatory in exploratory bottom fisheries. PECMAS is the NEAFC forum to discuss possible observer schemes for the purposes of scientific data collection, but there are no plans of implementing them at present (NEAFC, 2015).

The ICES VME Database contains by-catch data on VME indicators collected by observers from CPs. The ICES WGDEC uses these data to identify sensitive areas threatened by bottom fishing, and provides advice to avoid SAIs (ICES, 2016).

ICES WGDEC expert group meets annually to collate new information and map the distributions of VMEs in ICES areas, including the NEAFC RA. The resulting maps are combined with information on bathymetry and fishing activity to assess the risk to VMEs under the ICES standards and procedures. The assessments, mostly survey-based, are reviewed according the ICES Advice Process and published

in the ICES website. PECMAS receives the advice from ICES, discusses it and, if necessary, makes a proposal to the NEAFC Commission for appropriate action. The Commission then adopts the necessary measures to ensure protection of VMEs from any possible SAIs caused by fishing with bottom gears (FAO, 2016).

According to the NEAFC Recommendation 19: 2014 (Article 2e), SAIs has the same meaning and characteristics as those described in paragraphs 17-20 of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas.

The NEAFC general approach since 2008 has been to identify areas where VMEs are known or likely to occur, and to close these areas to bottom fishing activities to protect the VMEs from SAIs (FAO, 2016). ICES has advised NEAFC towards identification of VMEs and assessing where VMEs are likely to occur. To minimize risks to VMEs, areas where VMEs have been identified (e.g. on the Rockall Bank) and areas where VMEs have been considered likely to occur (e.g. on the MAR) have been closed to commercial bottom fisheries (NEAFC, 2008).

Commercial bottom fisheries are only allowed in areas where they were active between 1987-2007, and are thus classified as "existing bottom fishing areas". However, closures can be implemented within these areas as well if VMEs are identified as occurring or likely to occur (under a precautionary approach). Thus, NEAFC has confined bottom fisheries to areas where significant adverse impacts on VMEs are not likely to occur (NEAFC, 2012b). All other areas are either closed to bottom fisheries or classified as "areas outside existing bottom fishing areas" where only exploratory fisheries may take place under various conditions and limitations. Moreover, NEAFC implemented an encounter protocol with temporary closures in the event of fisheries encountering VMEs.

A1.5.5. Mapping of sensitive species and habitats

In the Rockall Bank there have been visual ground truthing surveys (RVs L'Atlante and Meteor), multibeam bathymetry surveys (NOC and Irish Seabed Survey), surveys within the EU HERMES programme (Duyl and Gerard, 2005), and dedicated UK video surveys (ICES, 2010; 2011; 2012a). Hatton Bank has been the object of Spanish multidisciplinary mapping surveys (Durán-Muñoz, et. al., 2009; 2012a), UK biological and geophysical surveys (Howell *et al.* 2007) and Dutch surveys conducted by NIOZ (ICES, 2010). In the Hatton-Rockall basin, UK video surveys collected data on sponge aggregations (ICES, 2013b) and towed camera transects from Marine Scotland ecological research survey. These have confirmed the presence of cold seep habitat and coral gardens (ICES, 2016). On the Mid-Atlantic Ridge, VMEs areas were identified based on information from the Mar-ECO programme, EcoMar surveys (UK) (e.g. Bell *et al.*, 2016), as well as published observations made by cameras on ROVs and bycatches in scientific bottom trawls (ICES, 2014). VMEs areas were identified on and around Josephine Seamount, based on available historical data on octocorals (ICES, 2012a).

On the Rockall Bank, ICES identified VMEs indicators based on by-catch data collected from Scottish fish stock assessment bottom trawl surveys (ICES, 2015).

Portions of the Hatton Bank and surrounding areas have been identified by ICES as VMEs areas based on by-catch data collected by observers from Spanish ad hoc science-industry cooperative surveys (Durán-Muñoz *et al.* 2011; 2012b). Coral data from Rockall (ICES, 2007) and Hatton Banks are available from Russian scientists and observers onboard fishing vessels (ICES, 2014).

Normally NEAFC CP fund their respective surveys and observers.

In the past, information on the presence of sensitive species and habitats was plotted by the WGDEC, and expert opinion was used to evaluate the likelihood of VMEs presence. In 2012, the ICES VME database was developed to provide a central storage system for information on VME (See Section Description of Sensitive Habitats and Species). Lately, WGDEC proposed a system to weight the reliability and significance of VME indicator records (ICES, 2014) and a VME Indicator weighting process (algorithm) was developed (ICES, 2016). WGDEC therefore sought to develop a system that would

formalize expert opinion and utilize relevant information from the ICES VME database. The current process for considering new data on VMEs is as follows (ICES, 2017):

i. New VME data are reviewed by the WGDEC and added to the ICES VME database. VME habitat records are stored as such. VME indicators are fed through the VME Indicator weighting algorithm. The weighting algorithm outputs are a gridded VME index layer and an associated gridded confidence score layer;
ii. VME habitats (vector) and VME index (grid) data are considered together in a GIS alongside other data layers including bathymetry. They are closely analysed if they highlight new sensitive areas or suggest changes to existing sensitive areas;
iii. When considering sensitive areas, records of VME habitat would be considered in preference over the VME Index. In the absence of VME habitat records, grid cells which scored a High VME Index and High confidence will be considered;
iv. If a VME Element can be identified from bathymetry data, then this will also be considered alongside the VME habitat/VME index layer. The scale of the VME element is important in deciding whether or not to use its entire extent;
v. If no VME element is identified, then the VME record or area of index grid is considered as a sensitive area;
vi. In all cases a buffer zone is applied to the sensitive area following ICES advice (ICES, 2013a);
vii. A boundary is then drawn around the buffered sensitive area (as simple shape as possible).

Mid Atlantic Ridge (MAR) & isolated seamounts: ICES advised that the MAR be regarded as one continuous combination of VME element (a chain of pinnacles, knolls, seamounts, ridges, and troughs that together make up one continuous VME element). ICES has not attempted to provide a boundary for the MAR. Moreover, ICES advised regarding all isolated seamounts outside the MAR whose summits are shallower than 2,000 m depth as VME elements. VME areas identified within the MAR and currently closed by NEAFC to bottom fishing represent about 6% of the total RA.

Rockall–Hatton Area: there are several geomorphological features that can be considered VME elements at fishable depths and currently open to bottom fisheries. This area also hosts different VME elements and VME indicator species identified by ICES, currently protected by fisheries closures implemented by NEAFC. These closures represent ~ 1% of the total RA.

WGDEC noted that predictive modelling studies suggested the presence of certain types of VME throughout parts of NEAFC RA (ICES, 2013b). However, as the science of predictive habitat modelling remains at a relatively coarse spatial resolution, ICES WGDEC does not feel able yet to recommend actions on the basis of predictive modelling. Coarser resolution models can offer useful information on the potential distribution of VMEs and VME indicator species through highlighting areas where VMEs are "likely to occur". In 2014, WGDEC (ICES, 2014) recommended that in the absence of reliable widespread biological sampling the use of predictive habitat models should be explored, and that management decisions made using coarse scale modelled habitat maps should be complemented with other finer scale information wherever available, including expert knowledge.

A1.5.6. Impact mitigation and protection

The term "encounter" means catch of VME indicator species in a fishing operation (such as a tow or gillnet or longline set) above threshold levels as set out in Article 9 of NEAFC Recommendation 19:2014. Catch of VME indicators must be quantified. If an encounter is observed when hauling trawl gear, the fishing vessel shall cease fishing and move out of an area defined as a 2 nm wide band (polygon) on both sides of the "track" of the haul during which the encounter occurred. The "track" is defined as the line joining consecutive VMS positions, supplemented by more exact information,

between the start and the end of the tow, extended by 2 nautical miles at both ends; If an encounter is discovered when using other bottom fishing gears, the fishing vessel shall cease fishing and move away at least 2 nautical miles from the position that the evidence suggests is closest to the exact encounter location. The skipper must report immediately the incident, and the "track" or position, to the flag state, which shall forward the information to the Secretary.

Encounter rules consider corals, sponges and VME indicators. They are defined as the presence of >30 kg of live coral and/or 400 kg of live sponge or VME indicators, in the case of towed gear, and fishing gear other than longlines; or the presence of VME indicators on 10 hooks per caught per 1000 hook segment or per 1200 m section of long line, whichever is the shorter, for longline sets.

No encounters have been reported, although several CPs have submitted to ICES data on sub-threshold bycatch of VME indicators. ICES (2012b) advices that this possibly reflects a combination of a decline in bottom fishing activities in the NEAFC RA, the recent introduction of closures that effectively exclude vessels from areas most likely to result in encounters, and an enhanced awareness and capability of vessels to avoid VMEs. It cannot be excluded, however, that the lack of reports also reflects some failure to report actual encounters.

Initially, the FAO Deep-sea Guidelines (FAO, 2009) and the work accomplished in NAFO were used as a basis for formulating the general approach for NEAFC regarding encounter rules. Since the first Encounter Protocol, dated 2008, such rules have been expanded and clarified several times under ICES advice (ICES, 2012b; 2013b).

Area closures for the protection of VMEs are areas where all bottom fishing activities, including exploratory bottom fisheries, are prohibited. The size of the bottom fishing closures currently amounts to about 7% of the total RA, and there are 19 different closed areas (Fig. A1.5.2).

If there is an encounter, the Secretary shall immediately inform all CP and ICES, and implement a temporary closure in the areas identified. PECMAS shall examine the temporary closure, and any relevant ICES advice, at its next meeting or by correspondence. If, on the basis of assessment by ICES, PECMAS advises that the area has or is likely to have a VME, the Secretary shall request CPs to maintain the temporary closure until such time that the Commission has acted upon the advice from PECMAS. If the PECMAS evaluation does not conclude that the temporary closed area has or is likely to have a VME, the Secretary shall inform CPs that may re-open the area to their fishing vessels.

Since January 2009, all commercial bottom fishing activities outside area closures and existing bottom fishing areas, or with bottom gear not previously used in the area concerned, are considered "exploratory bottom fishing" and must be conducted in accordance with an Exploratory Bottom Fishing Protocol (FAO, 2016). Prior to undertaking exploratory bottom fishing, CPs must send any relevant data to PECMAS and ICES, to facilitate a preliminary assessment of the risk of SAIs. Besides, CPs must send the Secretary a "Notice of Intent" and detailed information (harvesting plan, mitigation plan, recording-reporting system, catch-monitoring plan, data collection plan, and a preliminary impact assessment of the proposed bottom fishing activity) at least six months before the proposed start of the fishery. This information is forwarded by the Secretary to all CPs and PECMAS for review. ICES can provide guidance on the assessment to PECMAS. Exploratory bottom fishing shall only commence after having been assessed by PECMAS and approved by the Commission. Exploratory fisheries are assessed by ICES and PECMAS after two years, and the Commission takes a decision regarding the future of the fishery. NEAFC requires that all vessels undertaking exploratory fisheries carry an observer on board, who collects data in accordance with the VME Data Collection Protocol. Observers on fishing vessels undertaking exploratory fisheries in the RA shall: (a) Monitor any set for evidence of presence of VMEs and identify coral, sponges and other organisms to the lowest level; (b) Record on data sheets the following information for identification of VMEs: vessel name, gear type, date, position (latitude/longitude), depth, species code, trip-number, set-number, and name of the observer on data sheets, if possible; (c) Collect, if required, representative samples from the entire catch (biological

samples shall be collected and frozen when requested by the scientific authority in a CP); and (d) Provide samples to the scientific authority of a CPs at the end of the fishing trip.

Gillnets, entangling nets or trammel nets are forbidden at any position where depth is greater than >200 m (NEAFC, 2006).

The term "existing bottom fishing areas" refers to the distribution (with resolution of 5' latitude x 10' longitude) of bottom fisheries (all those in which gears contact with sea bottom) in the reference period 1987-2007. If new bottom fisheries were authorised in the future in new areas, these will also be defined as "existing bottom fishing areas". The first map of "existing bottom fishing areas" was adopted in 2009, and improved and modified in 2010 and 2014.

A1.5.7. Monitoring of VME impacts

Every 5 years, the Commission reviews the effectiveness of the regulations on the protection of VMEs from significant adverse impacts, taking into account any new scientific advice[106]. VME closures are usually implemented for periods between 1-5 years, and the measures controlling these closures are reviewed prior to the end date. Closures are normally extended, often with a modification of the boundaries (FAO, 2016).

The evidence for the distribution of VMEs in the NEAFC RA is reviewed annually by ICES WGDEC based on the most recent scientific information available, and relevant advice is delivered to NEAFC.

Most of the VME data available have been collected in different surveys carried out and funded by ICES State Members and NEAFC CP (FAO, 2016).

There are no obvious impediments preventing long-term monitoring of VMEs, other than some associated difficulties, such as data gaps.

There are no specific identification guides (VMEs indicator species) available for the NEAFC RA. However, the use of the NAFO coral and sponge guides is being considered, but there are known differences in the species composition between the RFMOs such that a new guide for NEAFC is most likely going to be prepared (ICES, 2012c).

[106] NEAFC Recommendation 19:2014

A1.6. NPFC

A1.6.1. Organisation, Data and Governance

The North Pacific Fisheries Commission (NPFC) is an inter-governmental organization established by the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. Informal consultations leading to the formation of the North Pacific Fisheries Commission began in 2006. These were followed by formal consultations and then Preparatory Conferences resulting in the signing of the *Convention on the Conservation and Management of the High Seas Fisheries Resources in the North Pacific Ocean*[107], on 24 February 2012, which came into force on 19 July 2015, 180 days after receipt of the fourth ratification.

The NPFC Convention applies to the waters of the high seas area of the North Pacific Ocean, excluding the high seas areas of the Bering Sea and other high seas areas that are surrounded by the exclusive economic zone of a single State. The area of application is bounded to the south by a continuous line beginning at the seaward limit of waters under the jurisdiction of the United States of America around the Commonwealth of the Northern Mariana Islands at twenty (20) degrees latitude north, then proceeding east and connecting the following coordinates:

- 20°00'00" N, 180°00'00" E/W;
- 10°00'00" N, 180°00'00" E/W;
- 10°00'00" N, 140°00'00" W;
- 20°00'00" N, 140°00'00" W; and
- East to the seaward limit of waters under the fisheries jurisdiction of Mexico.

The stated objective of the Convention is to ensure the long-term conservation and sustainable use of the fisheries resources in the Convention Area while protecting the marine ecosystems of the North Pacific Ocean in which these resources occur. The fisheries covered by the Convention include all marine species, i.e. fish, molluscs, crustaceans and other species caught by fishing vessels within the Convention Area. Exclusions to this list include sedentary species subject to the sovereign rights of coastal States and indicator species of vulnerable marine ecosystems as listed in, or adopted pursuant to the NPFC Convention; (ii) catadromous species; (iii) marine mammals, marine reptiles and seabirds; and (iv) other marine species already covered by pre-existing international fisheries management instruments within the area of competence of such instruments.

All fishing entities operating in the area who consent can be a Contracting Party. In the case of NPFC, "Contracting Party" means any State or regional economic integration organization that has consented to be bound by this Convention and for which the Convention is in force. Current membership includes 8 Members – Canada, China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, the United States of America, and Vanuatu.

[107] https://www.npfc.int/system/files/2017-01/Convention%20Text.pdf

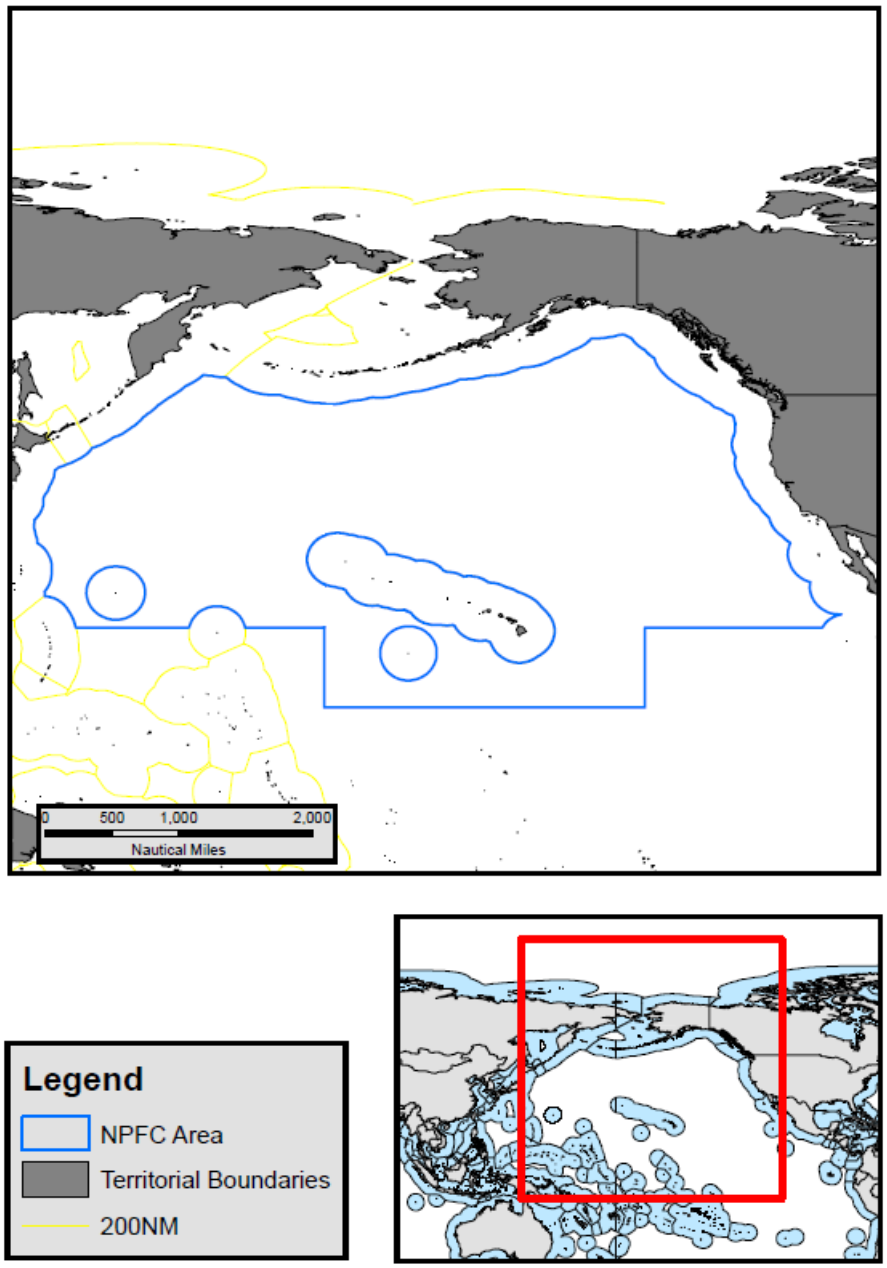

Figure A1.6.1 NPFC Convention Area[108]. Red area on bottom-right panel indicates extent of top panel.

The Commission is formed of all its Members and Cooperating Non-Contracting Parties.

The Commission is supported by three subsidiary bodies:

- the Scientific Committee (SC);
- the Technical and Compliance Committee (TCC) and
- the Finance and Administration Committee (FAC).

A small Secretariat, based in Tokyo, comprises an Executive Secretary, Science Manager, Compliance Manager and support staff including a Data Coordinator.

At present under the Scientific Committee, there are five such groups:

[108] https://www.npfc.int/about_npfc/convention_and_npfc_area_of_application

i. Small Scientific Committee on Pacific Saury (SSC PS);
ii. Small Scientific Committee on Bottom Fish (SSC BF);
iii. Small Scientific Committee on Vulnerable Marine Ecosystems (SSC VME);
iv. Technical Working Group on Pacific Saury Stock Assessment; and
v. Technical Working Group on Chub Mackerel.

As a result of the 3rd Commission Meetings the Technical and Compliance Committee formed three small working groups (SWGs) to address specific areas of its work plan:

i. SWG on Assessing Compliance;
ii. SWG on Vessel Registry; and
iii. SWG on Vessel Monitoring Systems (VMS).

The Commission, Scientific Committee and Technical and Compliance Committee meets annually with the first annual meeting occurring in 2017. Reports from each are available online[109]. Individual Member's Annual Reports are also provided.

Due to the recent formation of the NPFC the Conservation and Management Measures (CMMs) in place are rather limited.

The Commission, based on a review of the CMMs and the recommendations by the SC and TCC, has adopted the following CMMs[110]:

a) CMM 2016-01 On Information Requirements for Vessel Registration;
b) CMM 2017-02 To Establish and List of Vessels Presumed to Have Carried Out IUU Activities in the NPFC Convention Area;
c) CMM 2016-03 On the Interim trans-shipment procedures for NPFC;
d) CMM 2016-04 On Vessels Without Nationality;
e) CMM 2017-05 For Bottom Fisheries and Protection of VMEs in the NW Pacific Ocean;
f) CMM 2017-06 For Bottom Fisheries and Protection of VMEs in the NE Pacific Ocean;
g) CMM 2017-07 For Chub Mackerel;
h) CMM 2017-08 For Pacific Saury; and
i) CMM 2017-09 on High Seas Boarding and Inspection Procedures (Annex N), although Russia had indicated reservations.

However, a detailed research plan exists which has identified the following tasks:

i. Development of baseline assessment of the status of priority stocks
ii. Review of existing data standards in relation to stock assessments (e.g. Annual Report template, future vessel monitoring system)
iii. Stock delineation of important commercial species for the purpose of providing advice for the determination of management units
iv. For each commercial species, determination of data requirement, including data availability and data gaps; identification, where possible, of strategies to fill the data gaps, including for bycatch
v. Development of a standardized method to provide advice to the Commission
vi. Development of assessment models by species and research as required to determine various assessment parameters.

[109] https://www.npfc.int/commission-reports
[110] https://www.npfc.int/npfc-compendium-active-conservation-and-management-measures

The Technical and Compliance Committee (TCC) addresses compliance matters for the Commission through two key functions:

a) Monitor and review compliance with conservation and management measures adopted by the Commission and make recommendations to the Commission as may be necessary; and
b) Review the implementation of cooperative measures for monitoring, control, surveillance and enforcement adopted by the Commission and make recommendations to the Commission as may be necessary.

The TCC produces an annual report and a compliance workplan[111] which has two current priorities:

a) Targeting the conservation and management of Pacific saury and chub mackerel; and
b) Developing a Compliance Monitoring System (CMS).

Members can, in the case of serious infractions or non-compliance with the CMMs either by vessels flagged to members or vessels of non-members, place these vessels on a list of IUU vessels. This list is public and is shared with other RFMOs for their consideration and action as their rules may dictate. No established relationships with other RFMOs/ conservation groups were noted, though given the recent formation of the Commission this is not unexpected as these will develop over time. The SC notes that it is in the best interests of the Commission to seek synergies with other organizations with mutual interests and similar membership (e.g. North Pacific Marine Science Organization and North Pacific Anadromous Fish Commission).

Decision making is typical of an RFMO, with recommendations made by Scientific and Technical Committees being approved by the Commission, these recommendations being based upon work conducted by Members and subsidiary bodies.

Catch data are recorded in standard formats by flag States and stored by those flag States. VME data are recorded in standard formats by flag States including mitigation measures undertaken by exploratory fisheries as an explicit part of the CMMs for the NPFC Regulatory Area and data are required from vessels with 100% observer coverage to collect detailed scientific information on catches.

Vessels are tracked by their flag State currently by VMS, further details of how the VMS data is managed is currently not available, but a centralised VMS database is being discussed by NPFC. AIS is not specifically required under the Convention rules.

NPFC has an IUU list developed under CMM 2017-02[112]. There are currently 23 vessels on the NPFC IUU list.

Data and reports are published annually via the NPFC website. e.g. Small Scientific Committee on Vulnerable Marine Ecosystems reports[113]. The reports, with only one annual Commission cycle completed, detail the expected reporting outputs of the Commission and Committee meetings.

A1.6.2. Fishing activities controlled by the organisation

CMM 2016-05 (NE) and 2016-05 (NW) restrict fishing to depths shallower than 1500 m in the Pacific Ocean which effectively limits all bottom fishing activity to seamounts. The active fishing area (footprint) is not available from public data sources, but the full extent of the RA is about 27,690,000 km². Seamount activity by country by year has been reported in the NPFC-2017-AR-Annual Summary

[111] https://www.npfc.int/technical-and-compliance-committee-work-plan
[112] https://www.npfc.int/npfc-iuu-vessel-list

[113] https://www.npfc.int/meetings/meeting-type/21

Footprint - Bottom Fisheries[114]. The target species also include a number of pelagic species that will have negligible impact on VMEs so care should be taken when interpreting the reported effort data.

The main target species within NPFC are:

i. North Pacific armorhead (EDJ) *Pentaceros wheeleri*;
ii. Splendid alfonsino (BYS) *Beryx splendens*;
iii. Pacific saury (SAF) *Cololabis saira*;
iv. Neon flying squid (OFJ) *Ommastrephes bartramii*;
v. Japanese flying squid (SQJ) *Todarodes pacificus*;
vi. Chub mackerel (MAS) *Scomber japonicus*;
vii. Spotted mackerel (MAA) *Scomber australasicus*; and
viii. Japanese sardine (JAP) *Sardinops melanostictus*.

Pelagic fish and squid fisheries are the primary fisheries for NPFC Members (>99% of total catch of species covered by the Convention). Many of them are migratory species with wide geographical distributions which include both EEZs of the North Pacific Rim countries and High Seas areas covered by the Commission and therefore require close cooperation among CPs concerned to ensure adequate data collection, stock assessment and conservation measures for the species. Four fish species and two squid species are recognised by the Scientific Committee as priority species: Pacific saury (*Cololabis saira)*, chub mackerel (*Scomber japonicus*), spotted mackerel (*Scomber australasicus*), Japanese sardine (*Sardinops melanostictus*), neon flying squid (*Ommastrephes bartramii*) and Japanese flying squid (*Todarodes pacificus*). All six pelagic stocks are subject (in time) to formal assessment using quantitative approaches. An assessment plan detailing the completion of stock assessments for Pacific saury and the development of a framework and timeline for its regular improvement and update is ongoing along with conducting stock assessments for chub mackerel and other priority species considering their top-down prioritization (Spotted mackerel - Japanese sardine - Neon flying squid - Japanese flying squid). Identification of data gaps, determination of activities to address those gaps and development of standards and mechanisms for data collection and verification are also noted.

Data used for traditional stock assessment are sparse for bottom fish in the Convention Area, and it is unlikely that traditional stock assessment approaches will be applicable for most deep-water species. Unique life cycles, sporadic recruitment patterns and irregular spawning-recruitment relationships make accurate stock assessment difficult. Of the ten or so bottom species which have been exploited by fisheries in the Convention Area over the last decade, two are considered priority species for assessment, e.g. North Pacific armorhead (*Pentaceros wheeleri)* and splendid alfonsino (*Beryx splendens*).

Whilst stock assessments are on-going no quota has been allocated to CPs. Effort and catches by CPs are currently limited to historical levels.

The authorised fishing fleets and the most common gear types employed for each CP are described in Table A1.6.1.

[114] https://www.npfc.int/system/files/2017-10/NPFC-2017-AR-Annual%20Summary%20Footprint%20-%20Bottom%20Fisheries.pdf

Table A1.6.7 Authorised fleets in NPC by Member State and Vessel Type[115].

Vessel Type	Country							
	Canada	China	Chinese Taipei	Japan	Russia	South Korea	Vanuatu	Grand Total
Factory mothership					4			4
FISH CARRIERS		13	10	6	15	6	1	51
FISHERY RESEARCH VESSELS				1	2			3
FISHING VESSELS NOT SPECIFIED		52		138	14			204
FISHING VESSELS NOT SPECIFIED |Handliners		16						16
GILLNETTERS				1				1
Handliners		213						213
Handliners |FISHING VESSELS NOT SPECIFIED		12						12
Japanese type liners						1		1
Jigger vessels				64			4	68
LIFT NETTERS - using boat operated net				165		1		166
LIFT NETTERS - using boat operated net |Japanese type liners						22		22
LIFT NETTERS - using boat operated net |Liners nei			97					97
Liners nei			1					1
Longliners					1	2		3
MULTIPURPOSE VESSELS - Trawler-purse seiners	1							1
NON-FISHING VESSELS nei					4			4
PROTECTION AND SURVEY VESSELS				3				3
Purse seiners		104		5				109
SEINERS				47				47
Side trawlers freezer					7			7
Stern trawlers				5	1			6
Stern trawlers freezer		9			6	3		18
TRAP SETTERS - Pot vessels	2							2
TRAP SETTERS					2			2
TRAWLERS					26			26
TRAWLERS |Purse seiners					1			1
Grand Total	3	419	108	435	83	35	5	1088

It is currently not possible to determine the size distribution and number of vessels in the demersal fleets of each country due to the variety and number of "not specified" vessels in each fleet. Currently total effort (in fishing days per unit area per year) are not available to the public nor are full landings by species and gear type, though data do appear to exist for some individual CPs.

[115] Source https://www.npfc.int/compliance/vessels (Accessed 09/05/2018).

A1.6.3. Description of Sensitive Species and Habitats

In March 2018 a workshop was convened jointly by the NPFC and FAO in Yokohama, Japan to discuss the protection of Vulnerable Marine Ecosystems in North Pacific Fisheries Commission region[116]. However, the report of this workshop is not yet available, although it is expected (once the report is published) to contain essential information on the distribution and types of VMEs and VME indicator species known to occur in the region. The report and associated data will most likely serve as the basis for further discussions related to establishing possible VME fishery closures by NPFC and approaches for assessing SAI.

Accordingly, each CP, using the best information available, has been requested to evaluate which species or areas should be categorized as VMEs, and to identify areas where VMEs are known or likely to occur, including whether or not individual bottom fishing activities would have SAIs on such VMEs or marine species. The results of these tasks are to be submitted to and reviewed by the Scientific Working Group with a view to reaching a common understanding among the CPs. The following list of characteristics as defined by the International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO, 2009) are used as the criteria in the identification of VMEs.

i. Uniqueness or rarity - an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by other similar areas. These include:
ii. Habitats that contain endemic species;
iii. Habitats of rare, threatened, or endangered species that occur in discrete areas;
iv. Nurseries or discrete feeding, breeding, or spawning areas
v. Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, articular life-history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species.
vi. Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities.
vii. Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics:

NPFC currently recognizes four orders of corals as potential indicators of VMEs, e.g. Alcyonacea, Antipatharia, Gorgonacea, Scleractinia. With most VMEs in the NPFC RA tending to be located on or in close proximity to seamounts.

A1.6.4. Assessment of impacts upon sensitive species and habitats

NPFC has made extensive use of the International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO, 2009) in specifying the criteria for the assessment of Significant Adverse Impacts (SAIs). Such impacts are defined as those "that compromise the integrity of the ecosystem through changes in the structure or function of sensitive benthic communities in a manner that:

i. impairs the ability of affected populations to replace themselves;
ii. degrades the long-term natural productivity of habitats; or
iii. causes, on more than a temporary basis, significant loss of species richness, habitat or community types.

[116] https://www.npfc.int/meetings/npfcfao-workshop-protection-vulnerable-marine-ecosystems-north-pacific-fisheries

NPFC further notes the impacts should be evaluated individually, in combination and cumulatively, and that when determining the scale and significance of an impact, the following criteria, taken directly from the FAO guidelines (FAO, 2009), should be assessed:

i. The intensity or severity of the impact at the specific site being affected;
ii. The spatial extent of the impact relative to the availability of the habitat type affected;
iii. The sensitivity/vulnerability of the ecosystem to the impact;
iv. The ability of an ecosystem to recover from harm, and the rate of such recovery;
v. The extent to which ecosystem functions may be altered by the impact; and
vi. The timing and duration of the impact relative to the period in which a species needs the habitat during one or more life-history stages."

Fishery-independent surveys are not presently used to evaluate SAI directly, nevertheless as these have only been operational under the auspices of NPFC since 2016, it is expected that data from these surveys will at some point be sufficient to allow SAI to be evaluated, at least in relation to the first 3 FAO criteria described above.

Furthermore, all fishing vessels must have 100% scientific observer coverage to document any encounters with VME indicator species and to facilitate the assessment of potential impacts on VME through VME indicator species encounters, standardised data collection procedures have been established for observers for all gear types.

A1.6.5. Mapping of sensitive species and habitats

The NPFC Conservation and Management Measures (CMMs) CMM 2017-05 for the NW Pacific Ocean[117] and CMM 2017-06 for the NE Pacific Ocean[118]) stipulate that all fishing vessels must document all encounters with VME indicator species (irrespective of thresholds) and to make a note of their abundance/biomass by longitude and latitude. This is facilitated by vessels having 100% scientific observer coverage to record all the catch data. Furthermore, some CPs have produced individual overviews of VMEs in their own waters (e.g. United States[119]) but this does not extend to the entire NPFC region. However, due to the infancy of NPFC, insufficient data has been collated under the CMMs and by the fishery independent surveys to perform any substantive description, mapping, or assessment of VME and VME indicator species at this time.

A1.6.6. Impact mitigation and protection

The NPFC Regulatory Area covers an area of about 27,690,000 km² and is sub-divided into a Northeast and Northwest portion regions area supporting separate Conservation and Management Measures.

The corresponding VME conservation measures (CMM 2017-05 North-Western and CMM 2017-06 North-Eastern) do not specify VME encounter thresholds or associated move-on rules, but rather rely upon identifying and closing either know or possible areas of VME to bottom fishing activities.

Clear exploratory fishing protocols for the NPFC RA exist which include the following measures:

i. precautionary effort limits, particularly where reliable assessments of sustainable exploitation rates of target and main by-catch species are not available;

[117] https://www.npfc.int/cmm-2017-05-bottom-fisheries-and-protection-vmes-nw-pacific-ocean

[118] https://www.npfc.int/cmm-2017-06-bottom-fisheries-and-protection-vmes-ne-pacific-ocean-0

[119] https://www.npfc.int/overview-protection-corals-and-vmes-fished-and-unfished-areas

ii. precautionary measures, including precautionary spatial catch limits where appropriate, to prevent serial depletion of low-productivity stocks;
iii. regular review of appropriate indices of stock status and revision downwards of the limits listed above when significant declines are detected;
iv. measures to prevent significant adverse impacts on vulnerable marine ecosystems; and
v. comprehensive monitoring of all fishing effort, capture of all species and interactions with VMEs (including 100% VMS and observer coverage at all times).

Requests for exploratory fishing must be circulated by the proposing CP with the information and impact assessment to the members of the Scientific Committee (SC) for review and to all members of the Commission for information. The SC will review the assessment against established procedures, e.g. "SC Assessment Review Procedures for Bottom Fishing Activities" and then make a judgement (based upon the information provided) on the potential risks of SAI occurring should fishing be allowed in a new area.

The two NPFC conservation and management measures restrict existing fishing areas (footprint) to the current historical and reported fishing areas. Any new fishing areas would constitute an exploratory fishery and be subject to the above requirements.

A1.6.7. Monitoring of VME impacts

Other than the established fishery independent surveys there is no specific monitoring programme for VMEs in NPFC.

CPs may conduct *ad hoc* surveys such as those conducted by Japan to study cold-water corals and sponges in the existing fishing grounds of the Emperor Seamounts region.

A VME Identification guide has also been highlighted as something that would be useful during the 3rd SSC VME Meeting, but the document is currently not available.

A1.7. SEAFO

A1.7.1. Organisation, Data and Governance

South East Atlantic Fisheries Organization (SEAFO) is the RFMO that manages fishery resources in the high seas of the Southeast Atlantic. SEAFO was established on the initiative of Namibia in 1995. After several years of negotiations, the SEAFO Convention was signed in 2001, and entered into force in 2003. SEAFO is the first Convention to be drafted and to enter into force following the adoption of the 1995 United Nations Fish Stocks Agreement. This and the generally broader requirement to consider an ecosystem approach that commenced in the 1990s influenced the style of the SEAFO Convention, which can be considered the first of the modern fisheries conventions.

The SEAFO Convention, formally the "*Convention on the Conservation and Management of Fishery Resources in the South East Atlantic Ocean*", addresses the management of fishery resources within the Convention Area. The SEAFO resources include fish, molluscs, crustaceans, and other sedentary species, but exclude highly migratory species (typically tuna and tuna-like fishes) and some sedentary species, as listed in the 1982 LOS Convention.

The geographical coverage of the SEAFO Convention Area (SEAFO CA) is restricted to the high seas (i.e. outside national EEZs). The SEAFO CA (Fig. A1.7.1) is encompassed within FAO Major Fishing Area 47 and a small part of the eastern central Atlantic Ocean in FAO Major Fishing Area 34, but excludes the 200 nm EEZs of all national jurisdictions from Angola, Namibia, South Africa, and United Kingdom. The SEAFO Convention (2001) applies within the Convention Area, which is defined as "*all waters beyond areas of national jurisdiction in the area bounded by a line joining the following points along parallels of latitude and meridians of longitude: beginning at the outer limit of waters under national jurisdiction at a point 6°S, thence due west along the 6°S parallel to the meridian 10°W, thence due north along the 10°W meridian to the equator, thence due west along the equator to the meridian 20°W, thence due south along the 20°W meridian to a parallel 50°S, thence due east along the 50°S parallel to the meridian 30°E, thence due north along the 30°E meridian to the coast of the African continent.*"

The general principles of the Convention are to ensure the long-term conservation and sustainable use of the fishery resources in the Southeast Atlantic, in accordance with the ecosystem approach to fisheries management (SEAFO Convention Article 3). The Convention considers the impacts that fishing may have on non-target species and ecosystems, and identifies the need to minimize harmful impacts on living marine resources and protect biodiversity. It further stipulates the need to adopt measures based upon the best available scientific information and the application of the precautionary approach. SEAFO has adopted clear definitions of "fishery resources" and "living marine resources", with the latter defined as "all living components of marine ecosystems, including seabirds".

The SEAFO organizational structure, as defined in the Convention, consists of a Commission with three main subsidiary bodies (Fig A1.7.2): The Compliance Committee, the Standing Committee on Administration and Finance, and the Scientific Committee. The Contracting Parties (Angola, European Union, Japan, Republic of Korea, Namibia, Norway, and South Africa) are represented on the Commission and its subsidiary bodies, all of which meet annually.

In 2017, the SEAFO budget was N$5 169 382, which was covered: 30% countries sharing equal; 60% shared (75% developed countries – 25% developing countries); and 10% active fishing countries.

A Secretariat coordinates and supports the work of the Commission and its subsidiary bodies. It is based in Namibia, initially in Walvis Bay (2004), but it moved in 2011 to Swakopmund. The Secretariat is headed by the Executive Secretary who is assisted by a Data Manager and an Administrative Officer.

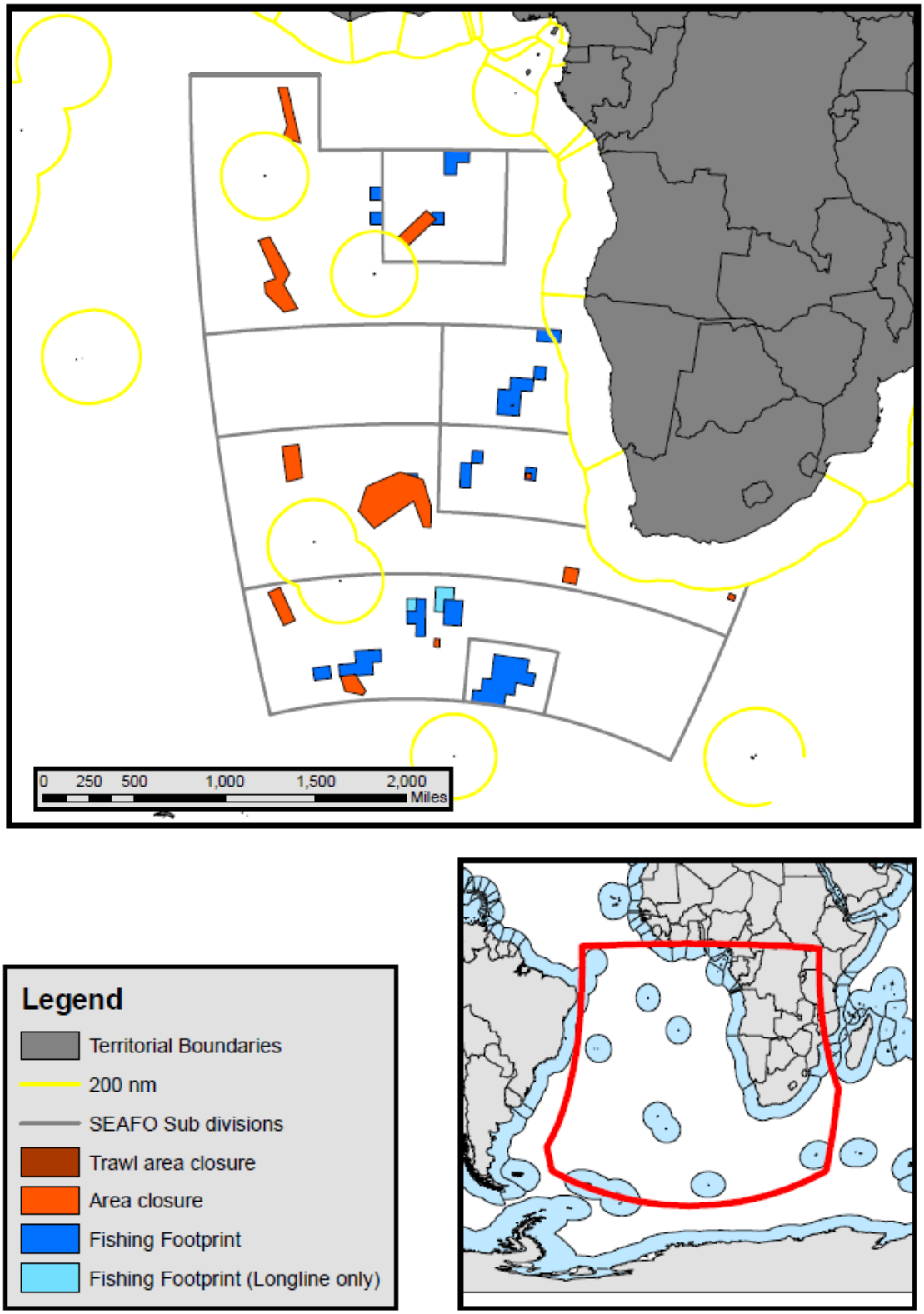

Figure A1.7.1 – Areas open to fishing and areas closed to protect potential VME areas from bottom fishing gears. Red area on bottom-right panel indicates extent of top panel.

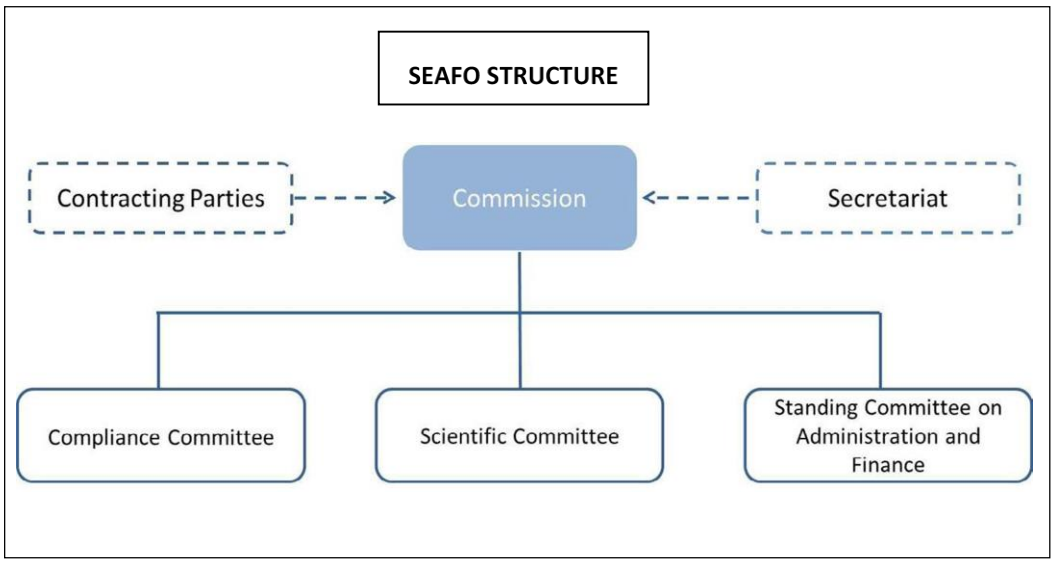

Figure A1.7.2 – Organizational structure of SEAFO (Source: FAO 2016)

At the 2017 Compliance Committee meeting, an in light of the much-reduced fishing activity in the Convention Area over recent years, it was proposed that SEAFO meetings should occur every two years. The Commission agreed to consider meeting physically on biennial basis coinciding with the years in which the SC provides advice on TAC's. However, to facilitate an appropriate assessment of stocks it was agreed that the SC should continue to meet physically on an annual basis.

Reports of the SC and CC meetings are all in the public domain and they are available on the SEAFO webpage. The SEAFO webpage also makes public several documents, such as the Stock Status Reports and the Species Profile documents.

SEAFO has established five specific Conservation Measures:

i. Total Allowable Catches [CM32-16][120];
ii. Measure on Bottom Fishing Activities and VMEs in the SEAFO CA [CM30-15][121];
iii. Reducing Incidental By-catch of Seabirds [CM25/12];
iv. Reduce Sea Turtle Mortality in SEAFO Fishing Operations [CM14/09][122];
v. Conservation of Sharks [CM04/06][123].

and two recommendations:

i. Recommendation on Banning of gillnets [Rec 1/2009];
ii. Recommendation - Banning of deep-water shark catches (103KB) [Rec01/08][124].

Recommendations are adopted by the Commission at its annual meeting and these are binding. Nevertheless, Contracting Parties have 60 days after notification by the Executive Secretary to submit reasons for not accepting an adopted measure.

The SEAFO website publishes the Conservation Measures (CMs), along with the SEAFO "System of Observation, Inspection, Compliance and Enforcement" (SEAFO System, 2017), which lays out all the requirements and procedures established by SEAFO to regulate its fisheries.

Issues relating to VMEs are addressed by the SEAFO Scientific Committee, and recommendations are presented to the Commission for consideration.

[120] http://www.seafo.org/media/1945f4cf-663a-4370-ad47-4ccc8e99c659/SEAFOweb/CM/open/eng/CM32-16_pdf
[121] http://www.seafo.org/media/8933d489-854c-4c99-895e-66573c7010a4/SEAFOweb/CM/open/eng/CM30-15_pdf
[122] http://www.seafo.org/media/14be4965-7007-4ed6-9fe0-327e1660e871/SEAFOweb/CM/open/eng/CM14-09_pdf
[123] http://www.seafo.org/media/eb0b21c1-734e-43ec-ac22-bf7a1d1a5157/SEAFOweb/CM/open/eng/CM04-06_pdf
[124] http://www.seafo.org/media/6b9c8563-e175-4386-a705-0056fdb9b6ce/SEAFOweb/CM/open/eng/Rec01-08_pdf

SEAFO held its first meeting in 2004, and introduced VMS for fishing vessels in 2005, with the intention of monitoring fishing operations in its Convention Area more closely. Other schemes, such as vessel documentation, catch and effort reporting and observer programs were introduced in 2006.

Information from fishing activities is collected by direct communication from the vessel to the SEAFO Secretariat. The data sources used for the compliance review includes all fishery-dependent data and information submitted to the Secretariat, namely: scientific observer forms, logbook forms, port inspection reports, vessel monitoring system (VMS) positions, entry (COE) and exit (COX) reports, 5-Day Catch reports and quarterly catch reports.

Electronic logbooks include information on haul/set and gear characteristics; catch; bycatch; discards; tagging; incidental catch; and VME-indicator units (encounter and move-on rules protocols; CM30/15). This fine scale information is available to the Secretariat at the end of fishing trips and are checked and validated by the data manager in consultation with the data provider before their use in the SC work.

A1.7.2. Fishing activities controlled by the organisation

All fishing activities in the SEAFO Convention Area (CA) occur on or around seamounts. Nowadays vessels concentrate fishing operations mainly in three distinct areas: the Valdivia Bank seamounts complex in division B1, the Discovery seamounts in division D0, and the Meteor seamounts in division D1.

Within SEAFO CA, depths shallower than 2,000 m comprise around 141,451 km^2 and these are considered as the areas for the potential fishing grounds (which represents 0.91 % of the total Convention Area which is 15,626,665 km^2). However, the current fishing footprint is smaller than the area of potential fishing grounds on account that most fishing occurs on or in close proximity to seamounts in the area.

In recent years, the main commercial target species exploited within the SEAFO Regulatory Area are the deep-sea red crab (mainly *Chaceon erytheiae*), alfonsinos (mainly *Beryx splendens*), Patagonian toothfish (*Dissostichus eleginoides*), and pelagic armorhead (cf. southern boarfish, *Pseudopentaceros richardsoni*). The SEAFO SC Committee develops or updates Stock Status Reports for all commercially-exploited species on an annual basis.

Alfonsinos and the southern boarfish are mainly caught by bottom and mid-water trawlers at SEAFO division B1 at depths ranging from 200 to 700 m. These fisheries typically occur on the top and along the slopes of Valdivia Bank, depending on the spatial distribution of the species and their circadian rhythm.

Deep-sea red crabs are mainly caught by the Japanese beehive pots, set in lines of about 400 pots (typically about 7.7 km in length), anchored at both ends. The fishery is focused mainly on the Valdivia Bank area (division B1), at depths of between 280 and 1,150 m.

Patagonian toothfish is caught with bottom longlines and trotlines. The main fishing areas are at the Discovery seamounts and around the Meteor complex seamounts in Subarea D. A smaller, more sporadic fishery targeting toothfish occurs on the western seamounts in Subarea D, at depths of between 900 and 1,500 m.

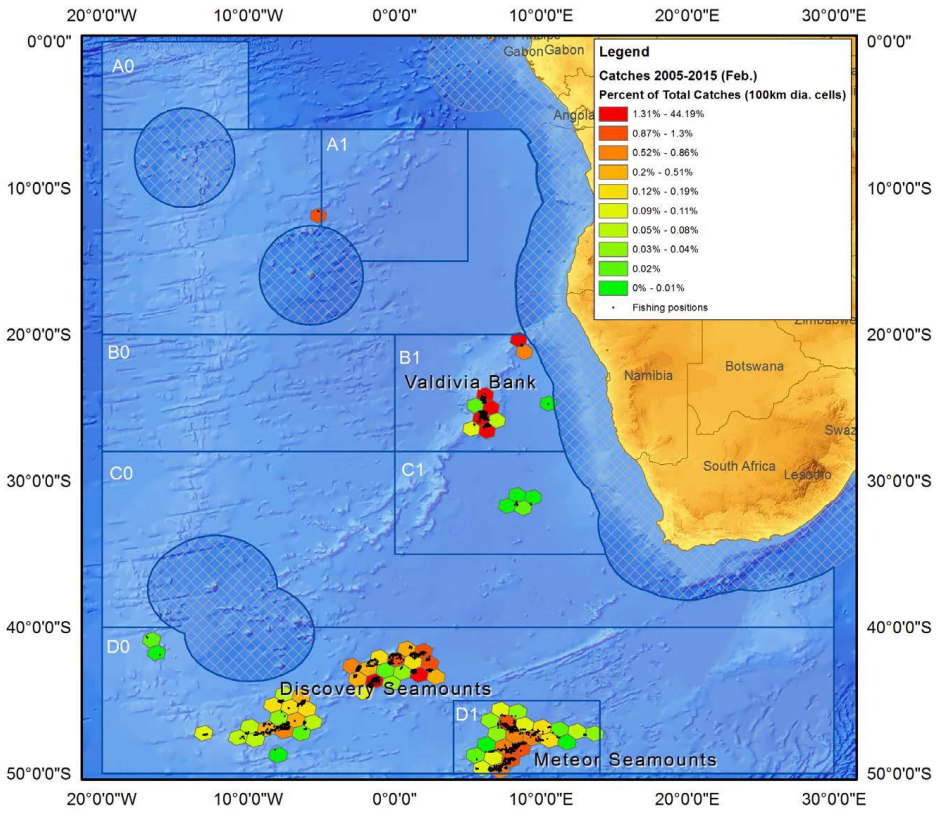

Figure A1.7.3 - Kernel density plot of fishing effort (number sets, trawl, etc.) between 2005 and 2014 (Source: FAO 2016 -SEAFO Secretariat).

A commercial bottom trawl fishery for orange roughy (*Hoplostethus atlanticus*) was conducted between 1995 and 2005, mainly on Valdivia Bank, on Ewing seamount, and on the northeastern part of the Walvis Ridge outside the Namibian EEZ (division B1).

The fishery targeting the Tristan da Cunha rock lobster (*Jasus tristani*) took place until 2006 on the Vema seamount, which is now a closed area.

Fish bycatches are dominated by the blackbelly rosefish (*Helicolenus mouchezi*) in the Valdivia Bank trawl fishery, and macrourid species (*Macrourus* spp.) in the Patagonian toothfish fishery. The annual report of the SEAFO SC includes detailed information on bycatch, discards, incidental bycatch (VME) and incidental mortality related to interactions with seabirds, mammals and reptiles.

Catches of SEAFO managed species are highly variable. The total annual catch has only exceeded 1,000 t in 2004 and 2010. In the SEAFO CA, the total catch of directed fisheries has decreased from 1,129 tonnes in 2010 to 161 tonnes in 2017 (Table A1.7.1). It is noteworthy that the total observed catch in 2010 was mostly due to a disproportionate large catch of pelagic armorhead (688 tonnes). Notably, 2016, is the first year in which deep-sea red crab was not fished since 2010 (DOC/CC/03/2017).

Table A1.7.1 – Catch (tonnes) and number of vessels operating in the SEAFO CA 2010-2017.

	Alfonsino (ALF)	Pelagic armorhead (EDR)	Deep-sea Red Crab (GER)	Patagonian toothfish (TOP)	Total	# of Vessels
2010	158.57	688.34	199.88	82.96	1129.75	4
2011	165.03	135.26	175.18	202.48	683.99	5
2012	172.38	118.36	197.65	124.64	613.03	4
2013	1.62	12.82	196.32	62.98	273.68	3
2014	0.00	0.00	134.40	53.38	187.78	2
2015	0.00	0.00	104.21	60.04	164.25	2
2016	0.00	0.00	0.00	39.56	39.56	1
2017	0.67	0.99	147.67	12.50	161.84	4
Total	498.27	955.78	1411.76	781.11	3646.92	

The SEAFO CA does not host a significant fishing effort, compared with other RFMOs (number of vessels, set/haul days) and most of the fishing activity is opportunistic because fleets share this activity with other vessels operating predominantly inside adjacent national EEZs, or are in transit between regions. Longline and pots are the main types of gear used in the CA.

The SC reviews the Total Allowable Catch (TAC) in a biennial basis and related management measures for patagonian toothfish, alfonsino, pelagic armorhead, orange roughy and deep-sea red crab, which are detailed in the Stock Status Reports. No robust stock assessment has been reached for any of these stocks up to now. In 2014, the Harvest Control Rules (HCR) were adopted for patagonian toothfish, alfonsino and deep-sea red crab, based on CPUE or catch trends. In recent years the TAC has not been restrictive as catches have been lower than the adopted TAC. This appears to reflect the reduced fishing activity in SEAFO CA in recent years and it might constrain the future use of HCR, to provide new advices on TAC. In such exceptional circumstances SEAFO has a protocol to consider a range of responses/ possible courses of action taking into account the degree and type of circumstance noted.

A1.7.3. Description of Sensitive Species and Habitats

The SEAFO VME indicator taxa, as defined in CM 12/08 (2008), are species of coral identified as antipatharians, gorgonians, cerianthid anemone fields, *Lophelia* spp., sea pen fields, and other VME elements. In 2013, the SEAFO SC agreed upon a slightly more extensive list of benthic invertebrates as provisional VME indicator taxa for the SEAFO Convention Area (SC Report, 2013). Although this list is reviewed annually there is no other definition of VME features, biodiversity indicators, or VME types defined for this region.

Table A1.7.2 – VME indicator taxa list.

Phylum/ Order/ Family	Common Name	Group/ Species Code
Porifera	Sponges	PFR
Gorgonacea	Gorgonian corals	GGW
Anthoathecatae	Hydrocorals	AZN
Scleractinia	Stony corals	CSS
Antipatharia	Black corals	AQZ
Zoantharia	Zoanthids	ZOT
Alcyonacea	Soft corals	AJZ
Pennatulacea	Sea pens	NTW
Bryozoa	Bryozoans	BZN
Crinoidea	Sea lilies	CWD
Ophiuroidea	Brittle/ basket stars	OWP

Serpulidae	Polychaete worms/ Annelids	SZS
Ascidacea	Sea squirts	SSX

A1.7.4. Assessment of impacts upon sensitive species and habitats

The SEAFO Conservation Measure CM29-14 aims to ensure the implementation by SEAFO of effective measures to prevent significant adverse impacts of bottom fishing activities on vulnerable marine ecosystems that, based on the best available scientific information known or likely to occur in the Convention Area, considered the guidance provided by the FAO in the framework of the Code of Conduct for Responsible Fisheries and any other internationally agreed standards, as appropriate.

For SEAFO the term "significant adverse impact" is equivalent to paragraphs 17-20 of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas.

As in other RFMOs, Bottom Fishing Impact Assessments (BFIA) are considered the first step to address SAI. However, SEAFO has not conducted any BFIA analysis to date, despite there being information available from the long-line fishery to estimate a cumulative fishing impact index using methods developed by CCAMLR and SPRFMO.

Following feedback from an independent Performance Review of SEAFO the Commission requested that SC consider cases of maximum acceptable impact which can be verified in terms of sustainable ecosystem impact on habitats and by-catch. However, SC during its 2017 meeting noted that given the limited data and knowledge linked to all (target and non-target) species within the SEAFO CA this request cannot presently be addressed. SC noted that the concept of "maximum acceptable ecosystem impact" is relatively new and it may take some time to develop a set of criteria for its implementation or evaluation. The SC recognized the need to identify different impacts, including pelagic fisheries associated with SEAFO CA seamounts and other anthropogenic activities. The SC considered with interest the FAO-ABNJ review and synthesis of the value of different sectors operating in the ABNJ (SC Report, 2017).

Up to now, measures adopted by SEAFO have been focused on the identification of potential VME and on preventing significant adverse impacts (SAI) through defining the percentage of VME closed to VME fished.

A1.7.5. Mapping of sensitive species and habitats

The occurrence of VME in SEAFO appears to be is closely associated with the steep flanks of seamounts and areas of seabed with abrupt morphology caused by volcanic and geological activity.

Table A1.7.3 List of research surveys undertaken in the SEAFO Convention Area (From FAO 2016).

Program and dates	Vessel	Area	Work
Spanish-Namibian cooperation 2008, 2009, 2010	R/V Vizconde de Eza	Ewing seamount and Valdivia Bank at the north-eastern end of the Walvis Ridge.	Multibeam echo sounder, CTD, bottom trawls, seismic profiles, rock dredge, sedimentary dredge, seabird and cetacean observations. (López-Abellán *et al.*, 2008). Depth range of surveys was 218-3,000 m
MarEco 2009 October-November	Russian vessel Brazilian vessel	Mid-Atlantic Ridge	The cruises have as main objective to map biodiversity and distribution patterns; exploratory fishing was not conducted
EAF Nansen January-February 2015	R/V Dr. Fridtjof Nansen		New information on vulnerable marine ecosystems and fishery resource

Table A1.7.3 summarizes the recent studies carried out in the SEAFO CA, with the main objective of mapping sea floor habitats for the detection of VME presence. The area surveyed by these studies is small relative to the total fishable area which is defined as seabed at depths less than 2000 m (e.g. 141,451 km^2; or 1% of all SEAFO Area). The results of the surveys resulted in the identification and subsequent closure in 2016 of a VME on the Valdivia Bank (total closure area 155 km^2) from the effects bottom trawling. Other closures are precautionary and in total represent 3.2% of total SEAFO CA. A further survey is planned under the auspices of the EAF Nansen research programme in 2019.

Records of VME indicator taxa have been recorded at depths ranging from 89 m (Vema Seamount) to 1,736 m with many types of VME indicator species being unlike those recorded from the North Atlantic.

Apart from fishery independent research cruises, data is also obtained from observes recording incidental by-catch of VME indicator taxa, which assists in defining identifying potential VME presence and impact of fishing activities.

Given the large area of the SEAFO CA and the paucity of good quality data, the development of habitat suitability models is not considered appropriate. However, data is compiled from observer records of VME indicator species. In the SEAFO Convention Area and pursuant to Article 6, paragraph 7 of CM 30/15, onboard observers shall:

1. Monitor any set for evidence of presence of VMEs and the identify coral, sponges and other organisms to the lowest level possible.
2. Record the following information for identification of VMEs: vessel name, gear type, date, position (latitude/ longitude), depth, species code, trip-number, set-number, and name of the observer on datasheets.
3. Collect representative biological samples from the entire VME catch. (Biological samples shall be collected and frozen when requested by the scientific authority in a Contracting Party). For some coral species that are under the CITES list this will not be possible and for these species photographs should be taken.
4. Provide samples to the scientific authority of a Contracting Party at the end of the fishing trip.

A1.7.6. Impact mitigation and protection

Initially, the SEAFO SC has only been able to identify geological features that were likely to support VMEs, but their actual characteristics remain largely uncertain. Despite the general paucity of detailed information available, SEAFO has made progress in response to UNGA Resolution 61/105 in protecting seamounts and vulnerable marine habitats from significant adverse impacts caused by fishing.

The SEAFO SC established a set of closures constituting a biogeographically representative selection of subareas likely to have VMEs. In their definition, and given the limited bathymetric and biological information available for the area, the SC applied the precautionary approach and consequently restricts its advice on VMEs to seamounts and seamount complexes with summit depths shallower than 2 000 m where VMEs are known or *likely* to *occur*.

In 2006, the SEAFO SC examined the available information relating to the ecosystem approach to fisheries and, following the precautionary approach, developed a list of 13 seamounts, or groups of seamounts, where VMEs are likely to occur, together with their known fishing exploitation history. On the basis of this advice, the Commission adopted measures to prohibit bottom fishing in 10 of the 13 seamount areas during 2007 – 2010[125].

In 2010, those VME closures were reviewed by the Scientific Committee, and the Commission agreed to:

i. reopen to fishing one existing seamount complex (Discovery seamounts in division D0);
ii. change the boundaries of six others which combined some into larger areas; and
iii. to close five new areas along the Mid-Atlantic Ridge.

In 2016, a VME area was established in the Valdivia Bank, based on evidence obtained from scientific research cruises. In this area only pots and longlines are permitted. Currently, SEAFO has a total of 12 VME areas closed to bottom fishing by all or selected gears, with a combined area of approximately 504,922 km^2 (3.2 % of the Convention Area).

SEAFO defined "existing bottom fishing areas" in 2008 as "areas where VMS data and/or other available geo-reference data indicating bottom fishing activities have been conducted within a reference period of 1987 to 2007" (CM 12/08), and requested Contracting Parties to provide information on historical bottom fishing. Using data from bottom longlines, pots and trawls, the Scientific Committee developed a "fishing footprint" map of the existing bottom fishing area at a spatial resolution of 1° x 1°. The Commission adopted the map in 2011. "New bottom fishing areas" can be added via an exploratory fishing protocol, which allows fisheries to start outside of the existing bottom fishing area, subject to stringent control and review measures.

Since 2014, four new 1° x 1° bottom fishing areas for commercial set longlines only have been added (Figures 31c and 31d in CM 30/15). Vessels can undertake "bottom fishing activities" in the SEAFO Convention Area, where the fishing gear is likely to contact the seafloor during the normal course of fishing operations. However, bottom fishing inside and outside of the defined existing bottom fishing areas is subject to the condition that it does not result in significant adverse impacts on VMEs, and additional restrictions apply when this is known to be occurring. Additionally, the use of new fishing methods and/or strategies is subject to an exploratory fishing protocol, even when it occurs within an existing bottom fishing area (CM 29/14, Article 2d).

SEAFO also defines an "encounter" as an incidental catch of a VME indicator species above threshold levels. Such that If the quantity of VME indicators caught in a fishing operation (such as trawl tow or set of a longline) is beyond the thresholds defined in Annex 6, the following shall apply:

(i) if an encounter is discovered the vessel master shall cease fishing and move away at least 2 nautical miles from the end of the trawl tow in the direction least likely to result in further encounters, defining a buffer area with a two nautical mile radius;
(ii) if an encounter is discovered in connection with other bottom fishing gears the fishing vessel shall cease fishing and move away at least 1 nautical miles from the position that the evidence suggests is closest to the exact encounter location, defining a buffer area with a 1 nautical mile radius. The master shall use his or her best judgment based on all available sources of information; and

[125] http://www.fao.org/in-action/vulnerable-marine-ecosystems/vme-database/en/vme.html

(iii) the master shall report the incident, including the track of the trawl or position determined under sub-paragraphs (i) and (ii), without delay to its flag State, which shall forward the information to the Executive Secretary immediately. Contracting Parties may opt to require their vessels to report the incident directly to the Executive Secretary.

In 2006, the Commission adopted a measure to implement a temporary closure based upon any catch of hard corals (CM 06/06, Paragraph 6). In 2008, the Commission adopted threshold values for live corals and sponges based on those adopted by the CM 26/13 for the northwest Atlantic Ocean, noting that these were precautionary. In 2009 the Commission revised the threshold levels downwards following the SEAFO SC advice. In 2011, no consensus was reached on threshold values for trawls, so the SEAFO SC proposed two different sets of values and, as a compromise, the Commission adopted separate threshold values for trawls, longlines, and pots. The thresholds for trawls were different inside and outside existing bottom fishing areas, but those for longlines and pots were the same for all areas. An encounter with VME indicator species is defined for each of the following fishing gears as follows:

a) Trawl tow – more than 600 kg of live sponges and/or 60 kg of live coral in existing fishing areas and more than 400 kg of live sponges and/or 60 kg of live coral in new fishing areas.
b) Longline set – at least 10 VME-indicator units (1 unit = 1kg or 1 litre of live coral and/or live sponge) in one 1,200m section of line or 1,000 hooks, whichever is the shorter, in both existing and new fishing areas;
c) Pot set – at least 10 VME-indicator units (1 unit = 1kg or 1 litre of live coral and/or live sponge) in one 1,200m section of line in both existing and new fishing areas.

The definition of VME indicator units for bottom longlines and pots is as follows:

a) The quantity of VME-indicator organisms (i.e. live corals and/or live sponges) recovered during hauling should be reported for each 1,200m section of longline or potline (in the case of longlines - or 1,000 hooks whichever is the shorter) as:

    i. Volume (litre) for VME-indicator organisms which fit into 10-litre container;
    ii. Weight (kg) for VME-indicator organisms which do not fit 10-litre container (e.g. branching species); and
    iii. VME-indicator units which is the combined total of volume of VME-indicator organisms which fit into 10-litre and weight of VME-indicator organisms which do not fit into containers of 10-litre (i.e. unit = volume + weight).

However, to date there have been no instances of encounters at or above threshold levels reported.

SEAFO uses the encounter threshold to trigger the immediate protection (through the “move-on” rule) of newly–identified potential VMEs, followed by a scientific assessment of these newly–identified areas and additional measures, if required.

Conducting fisheries research and basic marine science activities within areas closed for the protection of VMEs is subject to prior notification to the Contracting Parties and review by the Scientific Committee.

Exploratory fishing in new bottom fishing areas is subject to a protocol that includes the assessment of any potential impacts on stocks and VMEs in the intended fishing area. The measures also encourage the application of high resolution bathymetric surveys prior to fishing and the use of gear- monitoring technology, including cameras if practicable.

The above assessment requirement was first adopted by SEAFO in 2008 (CM 12/08), and has been subject to periodic revision, including the most recent measure (CM 30/15).

SEAFO has developed “Guidelines for revision of VME closures” and the principles underlying evaluations of appropriateness of VME closures and possible protocols for revision of closures. Opening of closures or revision of boundaries can only be considered if there is scientifically validated

evidence to conclude either; i. VMEs do not occur in a closed area (or are unlikely to do so), or ii. VMEs that occur in the closure are unlikely to suffer significant adverse impacts from fishing should the area be opened/modified.

A1.7.7. Monitoring of VME impacts

There are no established monitoring programmes dedicated to investigating VME impacts in SEAFO. All studies are either undertaken as a result of *ad hoc* research programmes or utilise data from the fishery and fishery independent surveys which are based on trawl sample data.

A1.8. SIOFA

A1.8.1. Organisation, Data and Governance

The Southern Indian Ocean Fisheries Agreement (SIOFA) is a multilateral agreement on the management of fishing in a vast area of the high seas in the South Indian Ocean. SIOFA is constituted under a legally-binding treaty and the Agreement was signed in Rome the 7th July 2006 and entered into force in June 2012.

To date, SIOFA has nine Contracting Parties, Australia, the Cook Islands, the European Union, France on behalf of its Indian Ocean Territories, Japan, the Republic of Korea, Mauritius, the Seychelles and Thailand. Additionally, Comoros, Kenya, Madagascar, Mozambique and New Zealand are also signatories to this Agreement but have not ratified it.

SIOFA objectives are to ensure the long-term conservation and sustainable use of the fishery resources, other than tuna, in areas that fall outside national jurisdictions through cooperation among the Contracting Parties, and to promote the sustainable development of fisheries in the Area, taking into account the needs of developing States bordering the Area that are Contracting Parties to this Agreement, and in particular the least-developed among them and small island developing States.

Actions that must be taken under SIOFA include:

- establishing effective mechanisms to monitor fishing in the area of SIOFA;
- providing annual reports on fishing operations, including amounts of captured and discarded fish; and
- conducting inspections of ships visiting ports of the Parties to verify they are in compliance with SIOFA regulations, and denying landing and discharging privileges to those who do not comply.

SIOFA applies to an area (Fig. A1.8.1), "*Commencing at the landfall on the continent of Africa of the parallel of 10° North; from there east along that parallel to its intersection with the meridian of 65° East; from there south along that meridian to its intersection with the equator; from there east along the equator to its intersection with the meridian of 80° East; from there south along that meridian to its intersection with the parallel of 20° South; from there east along that parallel to its landfall on the continent of Australia; from there south and then east along the coast of Australia to its intersection with the meridian of 120° East; from there south along that meridian to its intersection with the parallel of 55° South; from there west along that parallel to its intersection with the meridian of 80° East; from there north along that meridian to its intersection with the parallel of 45° South; from there west along that parallel to its intersection with the meridian of 30° East; from there north along that meridian to its landfall on the continent of Africa.*

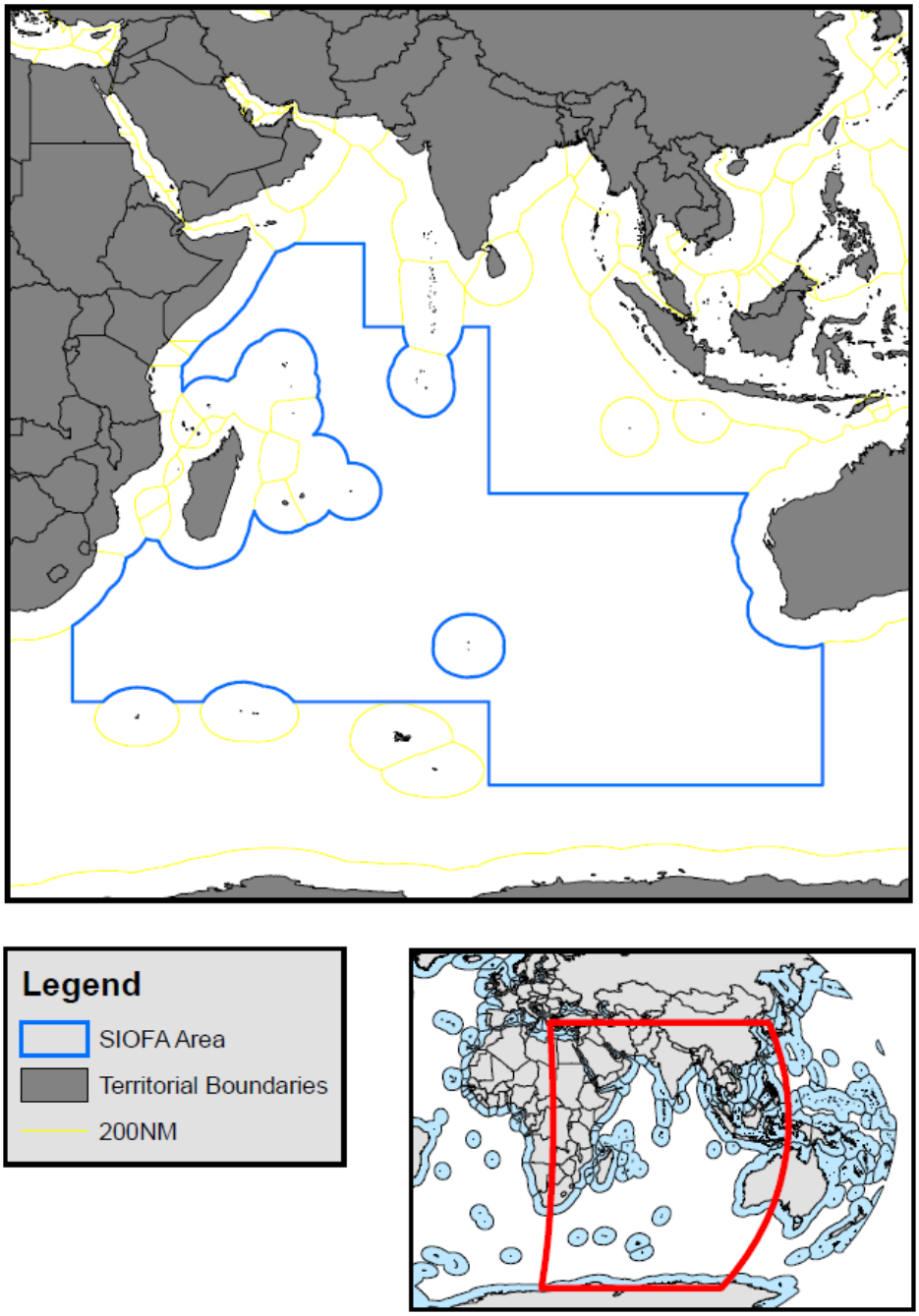

Figure A1.8.1 – SIOFA Agreement Area. Red area on bottom-right panel indicates extent of top panel.

The SIOFA organizational structure is headed by the Meeting of Contracting Parties which has consented to be bound by this Agreement and for which the Agreement is in force.

Decisions can be taken by SIOFA at the annual meeting or intersessionally. Each Contracting Party and each participating fishing entity shall be entitled to one vote. Two thirds of Contracting Parties and participating fishing entities, taken together, shall constitute a quorum. Whether a quorum has been reached is to be assessed at the time a decision is taken.

Decisions adopted by the Meeting of the Parties shall become binding on all Contracting Parties and participating fishing entities 90 days after the date the decision was transmitted by the Executive Secretary unless otherwise decided by the Meeting of the Parties. Votes shall be taken by show of hands unless a Contracting Party or participating fishing entity requests that the vote be taken by a roll

call or secret ballot and this request is supported by at least one other Contracting Party or participating fishing entity.

The Meeting of the Parties may take decisions intersessionally by electronic means (e.g. email, secure website) or by other means of communication in accordance with this Rule. The Chairperson may propose that the Meeting of the Parties take a decision intersessionally. Normally, the Meeting of the Parties shall only take intersessional decisions on matters of procedure. However, in exceptional circumstances, where an urgent decision is necessary, the Meeting of the Parties may take intersessional decisions on matters of substance.

Scientific advice provided in the form of recommendations from the Scientific Committee will comprise part of the agenda for the annual meeting. There does not appear to be a requirement for the advice of the Scientific Committee to be followed by the Commission.

Functions of the Meeting of the Parties are to:

a) review the state of fishery resources;
b) promote research and cooperation;
c) adopt generally recommended international minimum standards for fishing;
d) develop rules and procedures for monitoring of compliance by vessels; and
e) develop measures to prevent, deter and eliminate illegal, unreported and unregulated fishing.

The meeting of Parties has the responsibility of establishing the SIOFA subsidiary bodies: Scientific Committee, Compliance Committee and the Secretariat.

The ordinary meetings of the Scientific Committee are held once a year prior to the ordinary Meeting of the Parties, but extraordinary SC meetings may be decided by the Meeting of the Parties. To facilitate the work of the Scientific Committee the following work plans have been established:

i. Scientific Committee Work Plan
ii. Scientific Committee Operational Plan
iii. Scientific Committee Research Priorities Plan

The first Executive Secretary of the Southern Indian Ocean Fisheries Agreement' was appointed in 2016.

The Meeting of the Parties may also establish such temporary, special or standing committees as may be required, to study and report on matters pertaining to the implementation of the objectives of this Agreement, and working groups to study, and submit recommendations on, specific technical problems.

Functions of the Scientific Committee are:

a) to conduct the scientific assessment of the fishery resources and the impact of fishing on the marine environment, taking into account the environmental and oceanographic characteristics of the Area, and the results of relevant scientific research;
b) to encourage and promote cooperation in scientific research in order to improve knowledge of the state of the fishery resources;
c) to provide scientific advice and recommendations to the Meeting of the Parties for the formulation of the conservation and management measures referred to in Article 6(1)(d);
d) to provide scientific advice and recommendations to the Meeting of the Parties for the formulation of measures regarding the monitoring of fishing activities;
e) to provide scientific advice and recommendations to the Meeting of the Parties on appropriate standards and format for fishery data collection and exchange; and
f) any other scientific function that the Meeting of the Parties may decide.

Functions of the Compliance Committee are:

a) verify the implementation of and compliance conservation and management measures adopted by the Meeting of Parties; and
b) shall report, advise and make recommendations to the Meeting of the Parties.

Functions of the Secretariat are:

a) implement and coordinate the administrative provisions of this Agreement, including the
b) compilation and distribution of the official report of the Meeting of the Parties;
c) maintain a complete record of the proceedings of the Meeting of the Parties and its subsidiary bodies, as well as a complete archive of any other official documents pertaining to the implementation of this Agreement;
d) any other function that the Meeting of the Parties may decide.

SIOFA website publishes all the relevant information and an IT manager had been recently appointed. The maintenance and development of the SIOFA website is one of their responsibilities.

SIOFA are initiating the development of databases: VMS, vessel catch and effort data, observer data and others. A geospatial database containing SIOFA's historical fishing footprint, based on data submitted by Members is under construction. The IT Manager has the responsibility of developing all SIOFA databases as well as of monitoring of the integrity and security of SIOFA databases to ensure safeguarding of records in accordance with SIOFA's data confidentiality policy. The IT Manager is also responsible for the design and prepare reports, including data tables and maps based on Meeting of the Parties, Scientific Committee and Compliance Committee requirements.

The Contracting Parties, acting jointly under SIOFA Agreement, shall cooperate closely with other international fisheries and related organizations in matters of mutual interest, in particular with the South West Indian Ocean Fisheries Commission and any other regional fisheries management organization with competence over high seas waters adjacent to the Area.

Table A1.8.1 - List of proposals for 2018

MoP5-Prop13: Arrangement between SIOFA and CCAMLR	2018-05-30
MoP5-Prop14: MoU between SIOFA and ACAP	2018-05-30
MoP5-Prop15: SIOFA and SWIOFC Collaboration	2018-06-04

Table A1.8.2 – Current SIOFA CMMs that relate to. CMMs 2016/05, 2017/01, 2017/09 and 2017/10 will impact bottom-fishing activities.

CMM number	Binding	Title
2017/10	2017-10-09	Conservation and Management Measure for the Monitoring of Fisheries in the Agreement Area (Monitoring)
2017/09	2017-10-09	Conservation and Management Measure for Control of fishing activities in the Agreement Area (Control)
2017/01	2017-10-09	Conservation and Management Measure for the Interim Management of Bottom Fishing in the SIOFA Agreement Area (Interim Management of Bottom Fishing)
2016/05	2016-10-18	Conservation and Management Measure regarding the use of large-scale pelagic driftnets and deep-water gillnets in the Southern Indian Ocean Fisheries Agreement Area (Pelagic Driftnets and Deepwater Gillnets)

Each SIOFA CP, non-cooperating Contracting Parties (CNCPs) and Participating Fishing Entities (PFEs) undertaking bottom fishing activity in the Agreement Area is obliged, in accordance with CMM

2017/01 para 9, to disclose measures established in accordance with provisions relating to interim bottom fishing measures. Catch data are recorded by electronic or bound physical fishing logbooks. Data are collected from the fisheries including vessel catch and effort data relating to the trip (vessel, flag State, IRCS, tonnage etc.), conversion factors, detailed setting and hauling information (position, depth and time), catch retained, discards and incidental mortality. Observer data include length frequency data, biological sampling, data from incidental mortality, tagging data with specific effort data for each gear type used.

For VME taxa encountered the following data are recorded:

- Species (identified taxonomically as far as possible or accompanied by a photograph where identification is difficult);
- An estimate of the quantity (weight (kg) or volume (m3)) of each listed benthic species caught in the tow;
- An overall estimate of the total quantity (weight (kg) or volume (m3)) of all invertebrate benthic species caught in the tow;
- Where possible, and particularly for new or scarce benthic species which do not appear in ID guides, whole samples should be collected and suitably preserved for identification on shore;
- Collect representative biological samples from the entire VME catch. (Biological samples shall be collected and frozen when requested by the scientific authority in a Contracting Party). For some coral species that are under the CITES list photographs should be taken.

Each Contracting Party, CNCP and PFE shall ensure that all vessels flying its flag, that are fishing in the Agreement Area, are fitted with an operational automatic location communicator (ALC) unit reporting back to its competent authority during the period that they are active in the SIOFA regulatory area. Contracting Parties, CNCPs and PFEs shall develop, implement and improve systems to maintain a record of all vessel position information reported through VMS and logbooks, in relation to vessels flying their flags while these vessels are in the Agreement Area, such that this information may be used to document vessel activity in the Agreement Area, and to validate fishing position information provided by those vessels.

A1.8.2. Fishing activities controlled by the organisation

SIOFA resources include fish, molluscs, crustaceans and other sedentary species within the SIOFA Agreement Area, but exclude:

i) sedentary species subject to the fishery jurisdiction of coastal States pursuant to article 77(4) of the 1982 UN Convention on the Law of the Sea; and
ii) highly migratory species listed in Annex I of the 1982 UN Convention on the Law of the Sea.

The most important species are the pelagic armorhead (*Pseudopentaceros richardsoni*), the patagonian toothfish (*Dissostichus eleginoides*), the orange roughy (*Hoplostethus atlanticus*), deep-water sharks (Squaliformes) and alfonsino (*Beryx* spp.).

A compilation report on fishing activities undertaken on SIOFA Agreement area by SIOFA Contracting Parties, with an indication of the measures adopted in accordance with the provisions set out in para 9(1), has been submitted to the 4th Meeting of the Parties.

Some advances have been made regarding agreement on the time-period for defining the fishing effort footprint, but some issues remain with regard to the definition of ‘recently fished’. In accordance with Article 7(a) of CMM 2017-01 the SC recommends that by 2020 an appropriate SIOFA bottom fishing footprint will be defined and agreed.

In accordance with CMM201/07, SIOFA has established a Record of Authorised Vessels for fishing vessels authorised to fish in the Agreement Area.

For the purpose of the Conservation and Management Measures (CMMs), fishing vessels that are not entered onto the SIOFA Record of Authorised Vessels are deemed not to be authorised to fish for, retain on board, tranship or land fishery resources caught in the Agreement Area[126].

In accordance with paragraph 2 of CMM 2017/08 which pertains to establishing a Port Inspection Scheme, SIOFA Contracting Parties, CNCPs and PFEs designate ports to which foreign vessels may request entry. Any subsequent changes to this information shall be notified at least 30 days before the change takes place to the SIOFA Secretariat who will update the register accordingly.

At the 5th SIOFA Scientific Meeting an update on the status of submissions for the spatial extent of historical fishing effort data was presented, e.g. maps showing the intensity of catches and spatial distribution of historical fishing effort in SIOFA at 1º resolution for non-trawl (line, traps) and trawl (including bottom and midwater trawl) methods. Some historical fishing effort data were not reflected in the maps as they had been provided at a courser scale (e.g. FAO area). An overview of SIOFA fisheries in 2017 is available from the 5th SIOFA Scientific Meeting. This includes information on *Beryx* spp. (alfonsino), *H. atlanticus* (orange roughy), *D. eleginoides* (toothfish) and deep-water sharks.

Fleet composition, fishing effort and catches

At the 5th SIOFA Scientific Meeting a summary of the available information was presented. Between 2011 to 2017 (the most recent years reported by all parties), between 7 and 65 vessels fished each year in the SIOFA area during this period (Table A1.8.4). Provisional estimates of aggregated trawl effort (days) across CPs varied between 674 and 789 days between 2011 and 2014, and in 2015 total effort increased to 1,065 days (Table A1.8.5). Trawl hours are also reported by all the CPs except for the Cook Islands where reporting at this level is not applicable.

Provisional estimates of aggregated longline effort (hooks) across CPs and China show that the reported number of hooks was over 13 million in 2011. This has subsequently been reduced to 3.5 million hooks reported in 2016.

Table A1.8.4 - Number of vessels (trawl, bottom longline and gillnet) undertaking fishing in the SIOFA area by Contracting Parties and China. *Vessels use multiple gear types. ^Most vessels < 500 GRT.

Flag	Gear	Year						
		2011	2012	2013	2014	2015	2016	2017
Australia	Trawl	1	1	1	1	1*	1*	0
	Bottom Longline	0	0	0	0	1*	1*	0
Cook Is.	Trawl	3	3	2	2	2	2	2
EU	Bottom longline	2	2	2	1	1	2	2
	Gillnet	0	0	1	1	1	0	0
France (OTs)	Bottom longline	2	2	2	2	2	2	2
Japan	Trawl	1	2	2	1	2	2	2
	Bottom longline	0	0	1	0	0	0	1
Korea	Trawl	1	1	1	0	0	0	0
	Bottom longline	1	1	3	0	0	0	0
Thailand	Trawl	0	0	0	0	57^	60^	13^
	Seine trap	0	0	0	0	0	1	1
China	Trawl	0	0	0	0	0	0	0
	Longline	20	17	3	0	0	0	0
	Seine	0	0	0	6	6	8	5
Total	Trawl	6	7	6	4	62	65	17

[126] http://www.apsoi.org/sites/default/files/documents/SIOFA%20Record%20of%20Authorised%20Vessels%20-%20Public%20summary%202018%2003%2027%20.xlsx

	Bottom Longline	25	22	11	3	2	5	4
	Other	0	0	1	7	7	9	6

Table A1.8.5 – Fishing effort (trawl, bottom longline and gillnet) in the SIOFA area by Contracting Parties and China, a non-contracting party. Empty cells denote missing data.

Flag	Gear	2011	2012	2013	2014	2015	2016	2017
Australia	Trawl days	132	104	32	63	12		
	Trawl hours	294	252	62	106	14	26	
	Longline hooks (x 1000)	0	0	0	0	1,800	37,800	
Cook Is.	Trawl days	599	490	524	523	501	455	495
EU	Longline hooks (x 1000)					2,221	3,335	3,219
	Gillnet km	0	0	5,442	4,945	1,121	0	0
France (OTs)	Longline hooks (x 1000)	509	503	732	635	443	1	2
Japan	Trawl days	58	90	118	126	356		
	Trawl hours	550	528	1,001	707	2,260	2,500	
	Longline hooks (x 1000)	0	0	96	0	0	0	
Korea	Trawl days	50	238	217	0	0	0	0
	Trawl hours	286	623	233	0	0	0	
	Longline hooks (x 1000)	355	2,193	1,023	0	0	0	0
Thailand	Trawl tows					4,090	4,552	
	Traps					0	8	
China	Longline hooks (x 1000)	12,375	5,010	2,050	0	0	0	0
	Seine hours	0	0	0	4,500	10,000	4,000	300
Total	Trawl days	839	922	891	712	869		
	Trawl hours	1,130	1,403	1,296	813	2,274		
	Longline Hooks (x 1000)	13,240	7,707	3,902	635	2,664	3,374	
	Gillnet km	0	0	5,442	4,945	1,121	0	

The trawl catches are predominantly composed of *Beryx* spp. (alfonsino) and *H. atlanticus* (orange roughy). Species also caught by trawlers include *P. richardsoni* (pelagic armorhead), *Hyperoglyphe antarctica* (bluenose warehou), *Schedophilus velaini* (violet warehou), *Schedophilus velaini* (ocean blue-eye trevalla), Oreosomatidae (oreo dories), Epigonidae (cardinal fishes), and *Polyprion oxygeneios* (hapuku wreckfish). Thailand's fishery added *Saurida undosquamis* (lizardfish) and *Decapterus russelli* (scads) as a major catch from small trawlers since 2015. Some of the longline vessels (reported by Japan, Korea and France Overseas Territories) mainly catch *D. eleginoides* (Patagonian toothfish) and associated species such as *Antimora rostrata* (blue antimora). The other longline vessels catch *P. oxygeneios* (hapuku wreckfish), *S. velaini* (ocean blue-eye trevalla), *P. richardsoni* (pelagic armorhead), deep water sharks (Squaliformes), *Beryx* spp. (alfonsinos), *Plagiogeneion rubiginosum* (rubyfish) and *Mora moro* (common mora).

The gillnet vessels catches are predominantly composed of deep water sharks (Squaliformes), there is uncertainty on the species composition within this group. China's light seining fishery is targeting mackerel and *Brama* species (such as *Brama japonica*) and its bottom longline fishery is targeting ruby snapper and other species from the Lutjanid family.

According to paragraph 6 of CMM 2016/01 the SIOFA Scientific Committee should provide advice and recommendations to the Meeting of the Parties on the status of stocks of principal deep-sea fishery resources targeted, and, to the extent possible, taken as bycatch and caught incidentally in these deep-sea fisheries, including straddling fishery resources by 2019.

A1.8.3. Description of Sensitive Species and Habitats

SIOFA defines a Vulnerable Marine Ecosystem (VME) as a marine ecosystem which meets the criteria outlined in paragraph 42 of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO, 2009; FAO Deep-sea Fisheries Guidelines).

The only Conservation and management Measure implemented by SIOFA to mitigate impacts of bottom fishing on Vulnerable Marine Ecosystems (VME) is the move-on rule, which is triggered when certain thresholds of VME indicator generic types (sponges, corals etc.) are fished (Table A1.8.6). SIOFA has no published or defined lists of VME indicator species incorporated into its CMMs.

Table A1.8.6. Summary of VME thresholds and Management Responses that were provided in the 2017 National Reports submitted to 3rd Scientific Meeting.

Flag	VME Threshold	Management Response
Cook Islands	Trawl tow, the presence of more than 60kg of live coral and/or 400kg of live sponge.	Reported to Cook Islands within 24hrs of encounter.
	If any subsequent trawl within 1nm of the encounter trawl contains more than 30kg of live coral/ and or 200kg of live sponge.	The vessel must not fish within 5nm of that area until the Ministry of Marine Resources has completed an investigation. However, if the vessel deploys an underwater camera system on the trawl net, and the Cook Islands Observer verifies that no substantial VME structures are present, fishing can continue.
	Cook Islands vessels intending to transit any Benthic Protected area shall:	a. Give at least 24 hours advance notice to MMR prior to entering or exiting any Benthic Protected Areas; b. Ensure their vessel monitoring system polls once every hour while in the Benthic Protected Area; and c. Require that fishing gear is properly stowed before entering, and in transit through, a Benthic Protected Area and not be able to be deployed.
Korea	The threshold for all bottom fishing vessels@ 60kg of coral or 800kg of sponges per set	If the amount of VME that exceeds the weight specified in the criteria, the vessel shall apply a 2nm move on rule to resume its fishing operations. The vessel shall relocate its fishing position until it reaches a point where no VMEs are confirmed. In accordance with Article 15 of Distant Water Fisheries Development Act, an automatic location communicator shall be installed on all vessels conducting bottom fishing activities, and an observer shall be on board each vessel for over 50% of the total number of days fished during the trip.
Australia	Trawl: >50kg of corals or sponges in a shot for trawlers Line: >10kg of corals or sponges per 1000 hooks or 1200m section of line (whichever is shorter)	In SIOFA waters: a. If the combined catch of coral or sponge in any one trawl shot exceeds 50kg, the holder must cease fishing within an area two nautical miles either side of the trawl track extended by two nautical miles at each end of the trawl track; or b. If the combined catch of coral or sponge in any one shot for line method exceeds 10kg for any 1000 hook section of line or 1200m section of line, whichever is shorter; the holder must cease fishing within a radius of one nautical mile from the midpoint of the line segment. The holder must not fish in that area using the same method as used for that shot that triggered the limit until AFMA notifies otherwise. In SIOFA waters, if a vessel exceeds the limit then, as soon as practicable (but not later than 24hrs after the encounter), the concession holder must notify AFMA (Service One section), including the details of the shot including the location.

Japan		Following Article 11 of CMM 2016/01, Japan temporarily establishes threshold levels for encounters with VMEs and move-on protocols. For the trawl fisheries, as they operate in the mid-water, no threshold levels have been established. The threshold levels will be established when the observer recognizes that the operation is likely to come into contact with the seafloor or benthic organisms. As for the bottom longline fisheries, Japan applies those used in CCAMLR.
EU		The EU-Spain bottom longline fleet is applying the rules adopted by the Fishing Administration, similar to those applied in SEAFO and CCAMLR in the definition of the VME encounter and thresholds, together with the protocol adopted in CMM 2016-01.
Thailand	Bottom trawl: >700kg sponges, >60kg corals per operation. Line: >10kg of corals or sponges per 1000 hooks or 1200m section of line (whichever is shorter) Trap: >10kg sponges or corals	Stop fishing operations and move: • Bottom trawling: at least 2nm from the area; • Longline: at least 1nm from the centre of the line segment; • Traps: at least 1nm from the area Report to Dept. of Fisheries within 24hrs
China	No SAIs upon VMEs have been found for Chinese bottom fisheries, and no interactions with threatened, endangered and protected species were reported for the past bottom fisheries.	

A1.8.4. Assessment of impacts upon sensitive species and habitats

CPs, CNCPs or PFE, authorized or seeking to authorize any vessel flying its flag to bottom fish in the SIOFA Agreement Area is required to submit to the Secretariat, in accordance with CMM 2017/01, a Bottom Fishing Impact Assessment for its individual bottom fishing activities[127].

A1.8.5. Mapping of sensitive species and habitats

No comprehensive survey of SIOFA VMEs has been undertaken to date, nor have any habitat suitability models or species distribution models have been developed to date. CPs are currently requested to provide footprints of fishing activity along with fishing and observer data of baseline of activity and any other related fishery data, including VME presence and composition data. SIOFA CMM 2017/01 requires each Contracting Party, CNCP and PFE, to ensure that any vessel flying its flag and undertaking bottom fishing in the Agreement Area has an appropriate level of observer coverage. Bottom trawl vessels must have 100% scientific observer coverage for the duration of the trip and vessels using other bottom fishing gears must have 20% scientific observer coverage in any fishing year.

A1.8.6. Impact mitigation and protection

The total area of the SIOFA Regulatory Area is estimated at approximately 27,000,000 km². There are no subdivisions or proposed changes to create sub-divisions.

Williams *et al.* (2011) estimated that depths shallower than 2,000m were deemed fishable and made up about 1.7% of the SIOFA Regulatory Area (RA). Interactions between fishing vessels and potential VMEs were most likely to occur at depths shallower than 1,500m which constitute just 0.76% of the overall SIOFA RA.

[127] https://www.apsoi.org/bf-impact

In the absence of any specific threshold levels for VME encounters, which are under consideration, only provisional encounter thresholds apply (set by individual CPs) and these are the triggers used for the move-on-rules (SIOFA CMM 2017/01):

a) For bottom or mid water trawling, or fishing with any other net - two (2) nautical miles either side of a trawl track extended by two (2) nautical miles at each end;
b) For longline and trap activities - a radius of one (1) nautical mile from the midpoint of the line segment;
c) For all other bottom fishing gear types - a radius of one (1) nautical mile from the midpoint of the operation;

Threshold levels for VME encounters are established by individual Contracting Parties, CNCPs and PFEs. Encounters should be reported in their National Reports to the Scientific Committee in accordance with the guidelines at Annex 1, including any action taken by that Contracting Party, CNCP or PFE in respect of the relevant site. These reports will be made available (where such rules have been triggered) for the first time in 2018.

A number of proposals for closures (12 in all) have been submitted to the 2018 Scientific Committee for evaluation. Five of these were subsequently recommended by the SC for closure to the Meeting of Parties (MoP), but no consensus could be reached on the remaining seven. These were to be discussed during the 5th Meeting of Parties in 2018, with an apparent agreement to develop research and monitoring plans[128].

Fisheries footprints are currently being established by SIOFA. CMM 2017/01 requests Contracting Parties, CNCPs and PFEs, to provide to the Secretariat, by 31 January 2017, historical catch, effort and, if available, observer data during the period 2000 to 2015, and any previous years where available, in a format as close as to that given in the annexes of the CMM. The catch, effort and, if available, observer data provided to the Secretariat may initially be provided as unverified data and updated with verified data any time before 31 January 2018.

A1.8.7. Monitoring of VME impacts

VMEs and the impacts upon them are not currently monitored by SIOFA. There are currently no specific identification guides (VMEs indicator species) for SIOFA.

[128] SIOFA Meeting of the Parties 2018 Report: http://www.apsoi.org/sites/default/files/documents/meetings/MoP5%20Report%20FINAL.pdf

A1.9. SPRFMO

A1.9.1. Organisation, Data and Governance

The South Pacific Regional Fisheries Management Organisation is an inter-governmental organisation that promotes the long-term conservation and sustainable use of fishery resources in the South Pacific Ocean. Its remit covers the areas of the high seas of the South Pacific which equates to roughly a fourth of the world's high seas[129] (Fig. A1.9.1).

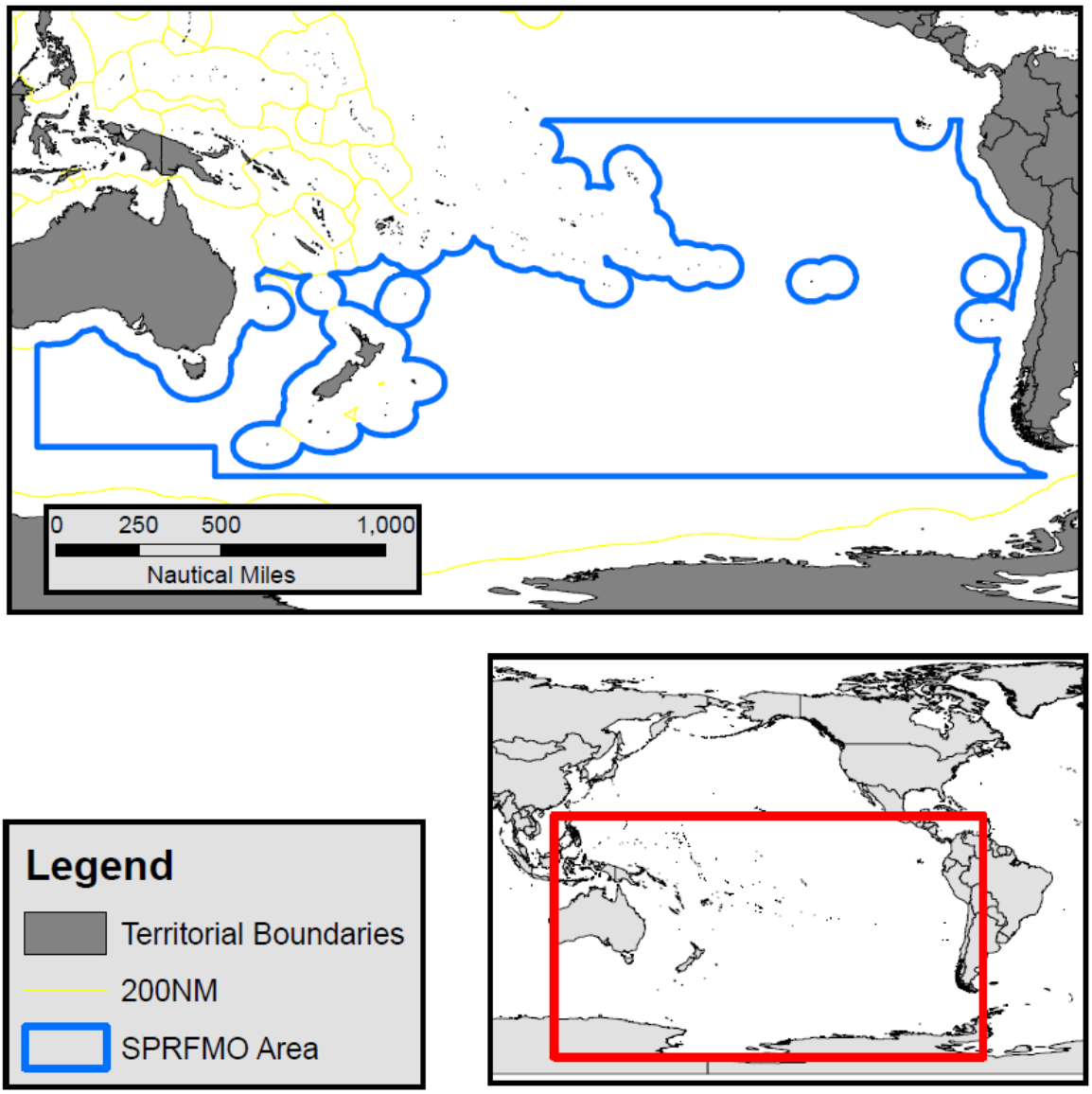

Figure A1.9.1. SPRFMO Area. Red area on bottom-right panel indicates extent of top panel.

In 2006, Australia, New Zealand and Chile began consultations to discuss a gap in the conservation and management of non-highly migratory fisheries and biodiversity in the high seas areas of the South Pacific. Following initial consultations, several international meetings were held which resulted in the creation of a regional fisheries management organisation with the responsibility to conserve and manage resources in the area. The Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean was adopted on the 14th November 2009, together with

[129] https://www.sprfmo.int/

a Resolution regarding the holding of a Preparatory Conference to assist the commencement of work of the newly formed South Pacific Regional Fisheries Management Organisation (SPRFMO).

The Convention presently consists of 15 Contracting Parties: Australia, Republic of Chile, People's Republic of China, Cook Islands, Republic of Cuba, Republic of Ecuador, European Union, Kingdom of Denmark in respect of Faroe Islands, Republic of Korea, New Zealand, Republic of Peru, Russian Federation, United States of America, Chinese Taipei, Republic of Vanuatu.

There are also four Cooperating non-Contracting Parties (CNCPs): Republic of Colombia, Curaçao, Republic of Liberia, and Republic of Panama. Requirements of membership are not specified, but countries, regional economic integration organisations and entities that wish to deposit instruments of ratification, accession, acceptance or approval in relation to the Convention can contact the Legal Division of the New Zealand Ministry of Foreign Affairs and Trade.

The Organisation consists of a Commission, a Scientific Committee, a Compliance and Technical Committee, an Eastern sub-regional Management Committee, a Western Sub-regional Management Committee, a Finance and Administration Committee and a Secretariat. The SPRFMO secretariat is based in Wellington, New Zealand and is composed of 6 staff members, consisting of an Executive Secretary, Data Manager, Coordination and Communications Officer, Finance and Office Manager, IT Manager and a Seconded Fishery Officer.

The Scientific Committee has established three working groups (WG) that include Jack Mackerel WG, Deepwater WG and Squid WG. All three WGs appear to meet once per year, although the squid WG only recently formed in 2017. The WGs might meet also on an *ad hoc* basis, but this is not clear from publicly available information.

A total of 16 CMMs have been implemented all of which are binding and four are of particular importance to bottom fisheries 02-2018, 03-2018,13-2016 and 14b-2018[130] (Table A1.9.1). There are no penalties for non-compliance with any of the CMMs.

Table A1.9.1 – CMMs of relevance to bottom fisheries

CMM #	Date entered into Force	Title
02-2018	05/05/18	Standards for the Collection, Reporting, Verification and Exchange of Data
03-2018	05/05/18	Bottom Fishing in the SPRFMO Convention Area
14b-2018	05/05/18	Exploratory Potting Fishery in the SPRFMO Convention Area
13-2016	29/04/16	Management of New and Exploratory Fisheries in the SPRFMO Convention Area

The mean annual budget is NZD $1,136,000 (EUR €677,258) based on the annual budget from 2018 and 2017. Currently each Member of the Commission is required to contribute to the annual budget based on Article 15, paragraph 2 of the Convention. This includes a basic fee of 20%, a national wealth component of 30% and a catch component of 50%. However, during the 6th Meeting of the Commission, a proposal to amend the SPRFMO budget formula was submitted. The current method can be volatile and can result in large changes in Members contributions over short time periods. The new method would include amendments to improve the predictability and fairness of the budget including changes to the basic fee formula, expanding the reference years to five years and use catch entitlements where available[131]. In 2018 the budget for scientific support was NZD$ 20,000 (€11,919.15 EUR). A further breakdown of what constitutes scientific support is not provided and therefore it is not clear whether this covers the management of target or bycatch species[132].

[130] https://www.sprfmo.int/measures/
[131] https://www.sprfmo.int/assets/2018-COMM6/Props/COMM6-Prop10-Chairperson-Budget-formula-complete-cv-f.pdf
[132] https://www.sprfmo.int/assets/2018-COMM6/00-Report-and-ANNEXES/COMM6-Report-Annex-4a-Budget-2018-19.pdf

The SPRFMO cooperates with other RFMOs, the FAO and other agencies of the UN now have mutual interests. Specifically, SPRFMO has Memoranda of Understanding (MoUs) with the Agreement on the Conservation of Albatrosses and Petrels (ACAP) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Within the Convention, the Commission is committed to understanding the conservation and management measures of other RFMOs and intergovernmental organisations and ensures al its decisions are compatible. It also seeks to cooperate and consult with other agencies and organisations to reduce and eliminate IUU fishing. The SPRFMO has links with organisations such as Asia-Pacific Economic Cooperation (APEC), Forum Fisheries Agency (FFA), Convention on Biological Diversity (CBD), United Nations Environment Programme (UNEP), and various RFMOs and other organisations[133].

The process for decision making is outlined in the Convention under Article 16. This details that decisions should be made in the absence of any formal objections. If the Chairperson determines that the decision cannot be made by consensus then the decision should be taken by a majority vote. For decisions regarding substance, the majority must be 75%. If a decision is made then the Commission must inform all members and it becomes binding after 90 days. Objections are allowed by any Member, but are only valid if that decision discriminates against a Member or is inconsistent with other provisions or international laws. Within the Scientific Committee, each Member can appoint one representative. The Committee's responsibilities are to plan, conduct and review scientific assessments, provide advice and recommendations to the Commission, promote cooperation in the Convention Area and provide other scientific advice if deemed relevant. If scientific advice cannot reach a consensus then all views of its members should be supplied to the Commission in a report. The Commission may seek alternative advice from scientific experts that may be relevant to issues in the Convention Area and periodically arranges an independent review of the reports, advices and recommendations of the Scientific Committee.

The annual total catch of key species in the SPRFMO Area is provided by the Secretariat and covers jack/horse mackerels (*Trachurus spp*), scombroid mackerels (*Scomber spp*), squid (*Dosidicus gigas*) and orange roughy (*Hoplostethus atlanticus)*. Other non-key species are also listed in the report and includes alfonsinos, cardinalfishes, morwongs, oreo dories, ruffs, barrelfishes, cephalopods nei, dogfish sharks, gadiformes, hapuka and sharks, rays, skates nei. Catch data are available on the SPRFMO website[134]. The Conservation and Management Measure on Standards for the Collection, Reporting, Verification and Exchange of Data (CMM 02-2018) requires Members and Non-Contracting Cooperating Parties to collate annual catch totals for live weight for all species and species groups. This information must be provided to the Commission by the 30th September and cover catches from January to December from the previous year. Depending on the gear type used by the vessel, the CMM provides the types of data that must be collected and requires data on non-target species to also be collected. Data must be recorded in the SPRFMO data submission template. In addition, all Members and CNCPs are required to implement observer programmes which are required to collect catch data for all fisheries and fished species in the Convention Area including target catch, bycatch and associated and dependent species. All data collected by observers must be supplied to the Secretariat using a standardised form and data is then held centrally in an observer database.

With regard to VMEs, all national observer programmes must collect data for each observed trawl. Data must be collected for all sensitive benthic species caught, in particular vulnerable or habitat forming species such as sponges, sea fans or corals. The types of data that are required include:

- Species (identified taxonomically as far as possible, or accompanied by a photograph where identification is difficult);

[133] https://www.sprfmo.int/cooperation/other-organisations/
[134] https://www.sprfmo.int/data/catch-information/

- An estimate of the quantity (weight in kg or volume in m^3) of each listed benthic species caught;
- An overall estimate of the total quantity (weight in kg or volume in m^3) of all invertebrate benthic species caught; and
- Where possible and particularly for new or scarce benthic species which do not appear in ID guides, whole samples should be collected and suitably preserved for identification on shore.

Within the SPFRMO, vessels must prepare and submit notification of encounters with VMEs. This is to include information on VME location, fishing gear, data collected such as oceanographic data or water chemistry and VME taxa[135]. CMM 03-2018 covers the Management of Bottom Fishing in the SPRFMO Convention Area[136]. The main objective of this measure is to promote the sustainable management of bottom fisheries including target stocks as well as non-target and bycatch species, along with other components of the marine ecosystems in which these resources occur. It applies to all Members and CNCPs that engage in bottom fishing activities and requires CPs:

- To prepare and submit to the Scientific Committee a bottom fishing footprint;
- Prohibit vessels flying their flag from participating in bottom fishing activities in the Convention Area, except in accordance with the provisions of this CMM;
- Limit bottom fishing catch to a level that does not exceed the annual average levels of that Member or CNCP over the period 1 January 2002 to 31 December 2006, except for in specified circumstances;
- Except for in specified circumstances restrict bottom fishing to within the bottom fishing footprint of that Member or CNCP;
- Pending the development of an SPRFMO Observer Program and until the Scientific Committee undertakes an assessment of likely impacts of gear types and stock assessments of principle deep-sea stocks:
    - for vessels using trawl gear in the Convention Area, ensure 100 percent observer coverage for vessels flying their flag for the duration of the trip.
    - for each other bottom fishing gear type, ensure that there is at least a 10 percent level of observer coverage each fishing year.
- Until the Scientific Committee has developed advice on SPRFMO threshold levels on what constitutes as evidence of an encounter, establish threshold levels for encounters with VMEs for vessels flying their flag;
- Require vessels flying their flag to stop bottom fishing activities within five nautical miles of any site in the Convention Area where evidence of a VME is encountered above threshold levels, and report the encounter to the Secretariat of the Commission so that appropriate action can be taken; and
- Members or a CNCP may exclude part of its bottom fishing footprint by dividing its footprint into areas open to bottom fishing, areas closed to bottom fishing and areas mentioned in the above paragraph. These exclusions must have the purpose of preventing significant adverse impacts to VMEs.

Under CMM 04-2017[137], SPRFMO details its process in establishing a list of vessels presumed to be involved in Illegal, Unreported and Unregulated Fishing (IUU). At least 120 days before the Executive

[135] https://www.sprfmo.int/assets/Fisheries/Conservation-and-Management-Measures/Annex-1-VME-encounters-CMM2.03-Bottom-Fishing.pdf
[136] https://www.sprfmo.int/assets/Fisheries/Conservation-and-Management-Measures/2018-CMMs/CMM-03-2018-Bottom-Fishing-8March2018.pdf
[137] https://www.sprfmo.int/assets/Fisheries/Conservation-and-Management-Measures/CMM-04-2017-IUU-List-27Feb17.pdf

Secretary hold their annual meeting, Members and CNCPs must provide a list of vessels presumed to be carrying out IUU fishing in the Convention Area over the past two years, accompanied by evidence to support their claims. This list is usually based on reports of violations against CMMs, trade information obtained by FAO statistics, information from ports States and other statistical information from national or international sources. This information is used by the Executive Secretary to develop a draft IUU list which is then open for comment. If a vessel has been listed on the draft list, the Member or CNCP must inform the owner of the vessel and the consequences of this. The draft and current lists are examined by the Compliance and Technical Committee and can remove vessels from the draft list if it deems necessary. At the annual meeting the Commission reviews the provisional list and on adoption of the final list requires all Members and CNCPs and non-Members to notify the owners of the vessel on the list and the measures required to eliminate the activities that were deemed illegal or unauthorised. The IUU list includes information on the name of the vessel, its flag, the owner's details and the reason for being blacklisted[138]. In 2018, there were three vessels on the IUU list, two of which were flagged to the Russian Federation and the other to Peru.

Scientific WGs appear to publish reports annually although there may also be further *ad hoc* meetings more frequently though this is not clear from the publicly available information. The SPRFMO has created a database which stores all Members and CNCPs standard data submissions including a list of vessels which are authorised to fish in the Convention Area. This information is publicly available on their website as well as catch information and information on the *Trachurus murphyi* fishery. Other data are available however individuals must register and be granted approval in order to see the entire SPRFMO Database.

A1.9.1. Fishing activities controlled by the organisation

Under the SPRFMO, bottom fishing refers to fishing using any gear type that is likely to come into contact with the seafloor or benthic organism during normal operations. Bottom Fishing Impact Assessments have been conducted by three Members (New Zealand, Australia and the EU). The assessment undertaken by New Zealand indicates that for bottom trawling depths range from less than 700 m to over 1,100 m. For bottom line fishing the depths were in general lower and ranged from 400 m to around 1,000 m. In the Australian impact assessment, trawls fished at depths of up to 1,400 m and demersal lines at approximately 1,500 m to 2,000 m. In the EU assessment depths ranged from 400 m to 2,000 m. For the different Members who have conducted impact assessments, their target species varies (Table A1.9.2).

Table A1.9.2 – Target species in SPRFMO area for New Zealand[139], Australian[140] and EU[141] flagged vessels.

Scientific Name	FAO Code	Australia	New Zealand	EU
Acanthocybium solandri	WAH			X
Allocyttus niger	BOE		X	
Arrears moor	RIB			X
Beryx decadactylus	BXD		X	
Beryx splendens	BYS	X	X	
Beryx spp	ALF			X

[138] https://www.sprfmo.int/assets/Fisheries/IUU-Lists/2018-IUU-List-for-Web.pdf

[139] https://www.sprfmo.int/assets/Meetings/Meetings-before-2013/Scientific-Working-Group/SWG-06-2008/a-Miscellaneous-Documents/New-Zealand-Bottom-Fishery-Impact-Assessment-v1.3-2009-05-13.pdf

[140] Full list of target species not publicly available. Source https://www.sprfmo.int/assets/Meetings/Meetings-before-2013/Scientific-Working-Group/SWG-10-2011/SWG-10-DW-01a-Australian-BFIA-Final-Report.pdf

[141] https://www.sprfmo.int/assets/Meetings/Meetings-before-2013/Scientific-Working-Group/SWG-08-2009/SP-08-SWG-DW-02-EC-Bottom-fishing-assessment-ENG.pdf

Centrophorus squasmosus	GUQ			X
Centroscymnus coelolepis	CYO			X
Dalatias licha	SCK		X	X
Deania calcea	DCA			X
Epigonus spp	CDL	X		
Epigonus telescopus	EPT		X	X
Gerypterus blacoides	COUS			X
Hoplostethus atlanticus	ORH	X	X	
Hyperoglyphe antarctica	BWA			X
Lophius piscatorus	MON			X
Macrouridae	RAT		X	
Merlucius australis	HKN			X
Mora moro	RIB		X	
Mustelus lunulatus	MUU			X
Neocyttus rhomboidalis	SOR		X	
Oreosomatids	ORD	X		
Pagrus pagrus	RPG			X
Paralithodes spp	KCS			X
Paristiopterus labiosus	BOA		X	
Polyprion americanus	WRF			X
Psenopsis anomala	BUP			X
Pseudocyttus maculatus	SSO		X	
Salilota australis	SAO			X
Schedophilus velaini	SEY			X
Sebastes marinus	REG			X
Squalidae	DXG			X

There are 12 target species in the SPRFMO Convention Area, but only the pelagic jack mackerel has been formally assessed. There are plans to undertake stock assessments for thirty deep water species and squid. At the present time no stock assessments have been completed that would impact VMEs. For jack mackerel there has been an assessment undertaken annually and quantitative methods and data are used[142]. There is a specific CMM dedicated to the management of jack mackerel which sets out effort controls based on total gross tonnage of vessels. Members and CNCPs agree, having regard to the advice of the Scientific Committee, that catches of *Trachurus murphyi* in 2018 throughout the range of the stock should not exceed 576,000 tonnes[143]. A framework for MSE is being developed for jack mackerel[144] but there does not appear to be any significant progress.

The Bottom Fishing Impact Assessment applies to all bottom fishing at all fishable depths within the SPRFMO Area. Interactions of fishing with potential VME areas occur on the continental shelf that make up 0.64% of the SPRFMO Area[145].

[142] https://www.sprfmo.int/assets/Meetings/Meetings-2013-plus/SC-Meetings/4th-SC-Meeting-2016/SC04-report/SC-04-tech-annex-7.pdf
[143] https://www.sprfmo.int/assets/Fisheries/Conservation-and-Management-Measures/2018-CMMs/CMM-01-2018-Trachurus-murphyi-8March2018.pdf
[144] https://www.sprfmo.int/assets/Meetings/Meetings-2013-plus/SC-Meetings/1st-SC-Meeting-2013/SC-01-17-Framework-to-Management-Strategy-Evaluation-for-the-South-Pacific-Jack-Mackerel.pdf
[145] https://www.sprfmo.int/assets/Meetings/Meetings-before-2013/Scientific-Working-Group/SWG-10-2011/SWG-10-DW-01a-Australian-BFIA-Final-Report.pdf

Within the SPRFMO Convention Area, 956 vessels are currently authorised to fish in 2018[146] the majority of which are over 20 m in length. It is not clear what proportion of this consists of demersal vessels, but for the whole area the most common types of gear include multi-rig otter trawl, drifting long lines, trawlers, purse seiners, handliners, longliners and pole and line. The total effort and effort distribution is unknown.

Catch data is provided on the SPRFMO website which details the species caught, the quantity (in tonnes), the year caught (back to 1974), the FAO area caught and the Member concerned. It does not provide detail on the catches per gear or data on landings. The main species caught are jack/horse mackerel, jumbo flying squid, orange roughy and *scomber* spp. The total catch of demersal species is low in comparison to the main pelagic species and varies between CPs and years. The most recent catches of demersal species are made by New Zealand and Australia and a small proportion from the European Union in 2014. Other Members have had almost no demersal catches for the last decade[147].

A1.9.3. Description of Sensitive Species and Habitats

It appears there are no VME indicator species officially documented in the SPRFMO Convention Area. However, Australia, New Zealand and the EU have undertaken Bottom Fishing Impact Assessments and data relating to the distribution of sensitive species and habitats from these assessments are likely to feed into the development of indicator species lists and threshold levels in due course.

SPRFMO uses the FAO criteria which define VMEs and VME species.

The current studies by Australia, New Zealand and the EU have identified a number of VMEs of different types, but these have not been consolidated to form a single list of VME types that are formally recognised by SPRFMO. Once a more complete view of activities and impacts across SPFRMO is available then it is expected that a standardised VME typology, and an associated list of VME indicator species will be established. Data on depth range of individual encounters are not publicly available. By contrast, the life histories of fish species encountered are quite well known as these are species found in other RFMO areas e.g. orange roughy.

A1.9.4. Assessment of impacts upon sensitive species and habitats

Fishery independent surveys are currently not undertaken to measure significant adverse impacts on VMEs. However, scientific observer coverage is maintained for all bottom fishing activities, with the highest impacting gear (trawl) requiring 100% coverage and all other bottom fishing gear types requiring at least 10% coverage.

There are standardised methods for recording encounters with VME indicator types (CMM 02-2018 Annex H: Detection of fishing in association with Vulnerable Marine Ecosystems). There should be an observer implementation report produced by each Member annually[148]. As threshold levels have not been established, significant adverse impacts (SAI) have not yet been defined by the organisation.

A1.9.5. Mapping of sensitive species and habitats

No fishery independent surveys have been conducted to date to map VMEs or sensitive habitats.

As indicated above observer coverage is present on all vessels (100% on trawlers and 10% on others) and observers will collect VME data. There is no indication from SPRFMO on how the service delivery model for observers is implemented. It is assumed that this would follow the normal observer

[146] https://www.sprfmo.org/Web/Vessels/VesselSearchView.aspx
[147] https://www.sprfmo.int/assets/2018-COMM6/COMM6-INF03-Data-Submitted-to-the-Secretariat.pdf
[148] https://www.sprfmo.int/assets/Meetings/Meetings-2013-plus/SC-Meetings/4th-SC-Meeting-2016/SC04-papers/SC-04-18-NZ-Observer-Implementation-Report-2016.pdf

provision rules applied by each CP. No decision has been taken on the relative value of observer data versus other data sources.

The only estimate found of VME coverage was in the Australian Bottom Fishing Impact Assessment, which indicates that the area which can potentially support VME is 0.64% of the total Convention Area. No habitat suitability or species distribution models to infer distribution of VMEs/ VME indicators are available.

A1.9.6. Impact mitigation and protection

The total area of the RA is approximately 59,000,000 km² and there are no sub-divisions and no proposed changes to the RA boundaries. The only estimate of fishable and VME area is from the Australian Bottom Fishing Impact Assessment that indicated that fishable areas are defined as depths of shallower than 2,000 m, which constitute 1.1% of the total RA. Interactions between fishing and potential VME areas occur mainly on the continental shelf and slope regions which constitutes about 0.64% of the total SPRFMO Area.

CMM 03-2018 (Management of Bottom Fishing in the SPRFMO Convention Area) provides recommendations for VME encounter rules. There are no threshold rules or move on rules currently adopted for any specific VME types.

CMMs are proposed by Members and there is no prerequisite level of data required to inform a new/ revised CM. There are no bottom trawling area closures, although New Zealand is proposing implementing closures for its vessels at the last Commission meeting, but it is unclear if these have been implemented. CMM 13-2016 defined the requirements for exploratory fishing in the SPRFMO RA. Observer, VME and fishing vessel data collection protocols are defined in CMM 02-2018. Exploratory fishing proposals are required when fishing vessel is proposed outside of the current footprint. There are no gear or depth restrictions in the SPRFMO Area.

A1.9.7. Monitoring of VME impacts

VMEs are not routinely monitored within SPRFMO. The priorities of SPFRMO are currently focussed on the definition of VME indicators and the identification of VME locations. There are no specific identification guides for VME indicator species, although some Members have been seen to adopt indicator guides from other RFMOs internally.

A1.10. WECAFC

A1.10.1. Organisation, Data and Governance

WECAFC is a regional fishery body and is responsible for promoting effective conservation, management and development of living marine resources within its area of competence[149]. At present, the FAO assumes responsibility for the operations of the organisation since WECAFC is classified as a Regional Fishery Body, rather than an independent RFMO. WECAFC has initiated the process of becoming established as a RFMO with a view to assuming an enhanced regulatory role. However, in a recent FAO performance review, 60% of the member states who responded stated that they did not see a need to change WECAFC's status, with the remainder being in favour of WECAFC becoming a RFMO.

The area of competence totals 205,075,545 km^2 and covers the Caribbean Sea and the western tropical and sub-tropical Atlantic, from 35°00 N[150] to 10°00 S (FAO major fishing areas 31 and northern part of 41). North of 5°00 N, the eastern boundary is at 40°00 W but extends eastward in southern areas of the area (30°00W between 0°00 and 5°00 N; 20°00 W south of 0°00). WECAFC borders NAFO and NEAFC to the north, CECAF to the east, and SEAFO to the south-east. There is currently no organisation responsible for the SW Atlantic. Additionally, WECAFC works closely with CRFM (the Caribbean Regional Fisheries Mechanism), OSPESCA (the Organisation of Fisheries for the Central American Isthmus) and IFREMER (the French Research Institute for the Exploration of the Sea). Additionally, the Caribbean Large Marine Ecosystem programme has several links with the work of WECAFC.

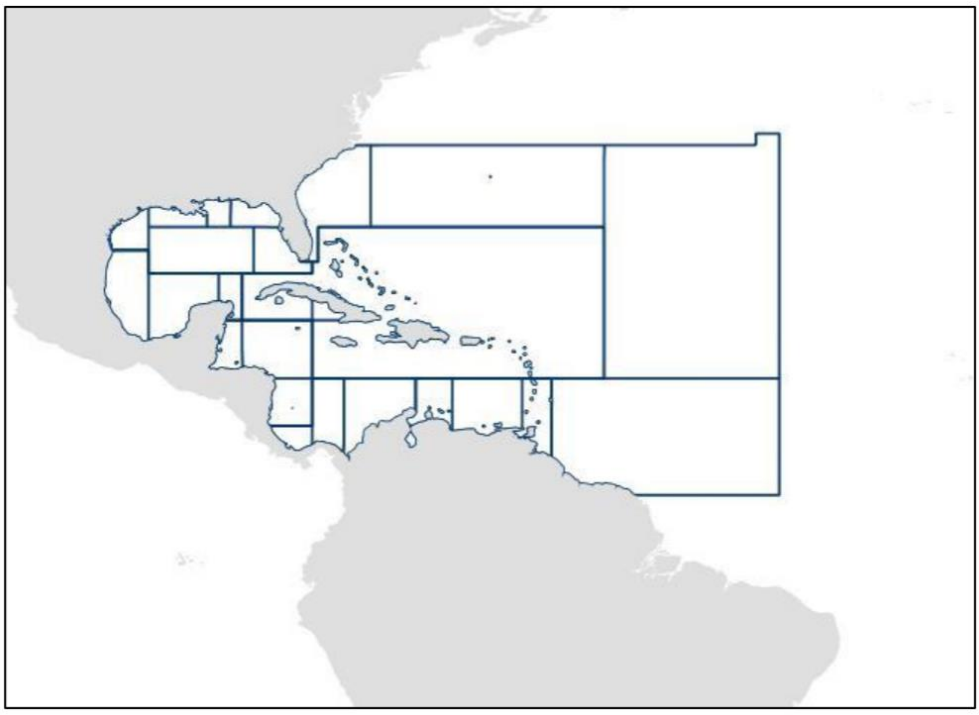

Figure A1.10.1 – Proposed sub-divisions of the WECAFC area[151] (FAO major fishing area 31). The Commission has not formally commented on this designation, nor how it proposes to divide its portion of FAO area 41 (northern Brazil Coast).

[149] WECAFC Introduction and strategic planning (2014): http://www.fao.org/3/a-i5096t.pdf
[150] Except 40° - 42° W where the northerly margin is 36°N
[151] Data and Statistics WG http://www.fao.org/fi/static-media/MeetingDocuments/WECAFC/FDSWG/2018/WECAFC_Data_Collection_Reference_Framework.pdf

Both national waters and areas beyond national jurisdiction are covered by the area of competence, but WECAFC does not have a regulatory area and is currently unable to enact binding measures. Upon adoption of the relevant instruments and convention texts, the regulatory area will constitute approximately 51 % of the convention area[152]. 89 and 86 % of the convention area covers waters deeper than 400 and 1000 m respectively.

There are 34 contracting parties (Table A1.10.1). Membership is subject to either being a coastal state or having flagged vessels fishing within the area of competence.

Table A1.10.1 – WECAFC CPs

Antigua & Barbuda	Grenada	Panama
Bahamas	Guatemala	Republic of Korea
Barbados	Guinea	St Kitts & Nevis
Belize	Guyana	St Lucia
Brazil	Haiti	St Vincent & the Grenadines
Colombia	Honduras	Spain
Costa Rica	Jamaica	Suriname
Dominica	Japan	Trinidad & Tobago
Dominican Republic	Mexico	UK
EU	Netherlands	USA
France	Nicaragua	Venezuela

WECAFC is nominally concerned with 'all living marine resources' in its area[153], but in practice, highly migratory species will be more directly managed by ICCAT. The specific responsibilities of the Commission are to:

a) Contribute to improved governance and promote co-operation between members;
b) Assist members in developing and implementing fisheries instruments that are consistent with the FAO code of conduct for responsible fisheries;
c) Promote collection, exchange and analysis of biological, environmental and socio-economic data;
d) Strengthen institutional and human capacity amongst members, through education and training;
e) Facilitate the management of stocks that straddle territorial boundaries of members;
f) Seek funding for the Commission's operations and for member states to initiate projects relating to the conservation, management and development of living resources.

The Commission is supported by a Scientific Advisory Group (SAG), comprised of five nominated scientists, which meets biennially. The SAG, together with the working groups, provide scientific advice to the Commission. The current WGs, formed between 2012 and 2017, are:

i. OSPESCA/ WECAFC/ CRFM/ CFMC WG for Spiny Lobster (in particular *Palinurus argus*)
ii. WECAFC/ OSPESCA/ CRFM/ CFMC WG for Recreational Fisheries
iii. CFMC/ OSPESCA/ WECAFC/ CRFM WG for Queen Conch
iv. IFREMER/ WECAFC WG for the Development of Sustainable Moored Fish Aggregating Device (FAD) fishing in the Lesser Antilles
v. CRFM/ WECAFC WG for Flying Fish in the Eastern Caribbean
vi. WECAFC WG for the management of deep-sea fisheries
vii. CFMC/ WECAFC WG for Spawning Aggregations

[152] http://www.fao.org/fishery/docs/DOCUMENT/wecafc/WG_2012/WECAFCWGmanagement-deep-sea-fisheries.pdf
[153] http://www.fao.org/fishery/rfb/wecafc/en#Org-Outputs.1

viii. WECAFC/ CRFM/ OSPESCA Fisheries Data and Statistics WG (FDS-WG)
ix. WECAFC Regional WG on IUU fishing.
x. WECAFC WG on Brazil-Guianas Shrimp and Groundfish

Currently, the vast majority of the working budget (approx. USD$ 220,000) is met by contributions from the FAO (WECAFC Secretariat, 2016). Further capital is contributed on an ad hoc basis by coastal states and various independent funds. As part of the process of establishing itself as a RFMO, WECAFC is currently considering options for how future funding contributions will be allocated (Hoydal, 2016). There are three main schemes under consideration, specifically those of NEAFC, the GFCM and a custom scheme, with an initial estimated budget of USD $ 1.56 million, upon establishment of RFMO status. This would place the financial burden upon the member states, rather than the FAO, which is understood to be part of the reason for the relatively low support (40 %) amongst members for WECAFC establishing itself as a RFMO (SLC & WECAFC, 2014)

WECAFC aims to foster increased sharing of catch data between member states and other fisheries organisations, but it is unclear at this point the extent to which catch data are collected and processed centrally. The Fisheries Data and Statistics WG (FDS-WG) works across WECAFC, CRFM and OSPESCA and aims to provide best practice guidelines, create standardised data collection formats and coordinate projects relating to catch data (SAG, 2017). FDS-WG is also responsible for the development of a regional database and assisting member states in supplying data to other RFMOs (e.g. ICCAT).

VME data are not currently collected. This has been raised as an area for improvement by the WECAFC working group for the management of deep-sea fisheries, which was established in 2012[154]. The proposed work has been recommended with conforming to FAO best practice and the efforts of other RFMOs, but whilst WECAFC has no regulatory powers, it is unable to establish any spatial management regime in ABNJ.

A1.10.2. Fishing activities controlled by the organisation

There are approximately 30 main target species, or species groups within the FAO statistical area 31 (most of the WECAFC area, but excluding areas of Brazil margin south of 5 °N), with small pelagics (herring, sardine, menhaden…) usually comprising the largest proportion (400 of 1500 kilotonnes in 2013; WECAFC, 2016/2). The majority of demersal target species are reef and inshore species (fish and invertebrates), with only a small proportion of the total catch being comprised of deep-water demersal species. Within FAO major catch area 31 between 2012 - 2016, about 0.5 – 0.7 % of the annual tonnage is comprised of demersal species, compared with A1.1 – 24 % lobster species, 3.8 – 4.6 % tunas (and other similar spp.) and 41.5 – 50.8 % of small pelagic species (FAO Catch Database). Significant demersal species landings include scabbardfishes & hairtails (Trichiuridae), in particular *Trichiurus lepturus* (2822 – 4762 tonnes between 2014 – 16), but the majority of demersal species landings reported in the FAO catch dataset are not classified to any meaningful degree (e.g. 'Misc. demersal fisheries': 7,343 – 9,362 tonnes between 2014 and 2016 or 'Demersal percomorphs': 2,565 tonnes per year 2014 – 2016). The paucity of catch data and vessel information has been noted as a considerable risk to VMEs within the WECAFC convention area (WECAFC, 2016/8). The size of the fishing area is poorly known and there has not been a bottom fishing footprint established.

Although there are no stocks for which WECAFC is directly responsible, WECAFC scientific working groups are involved with assessments and advice for spiny lobster, queen conch and flying fish, as well as others focussing upon particular gear types or wider ecosystem concerns. The mandate for the Spiny lobster WG includes a requirement to 'compile and analyse data on spiny lobster'[155], but at present this work is more geared towards analysing general trends in stock status and distribution, rather than

[154] http://www.fao.org/fishery/docs/DOCUMENT/wecafc/WG_2012/WECAFCWGmanagement-deep-sea-fisheries.pdf
[155] OSPESCA/ WECAFC/ CRFM/ CFMC WG on Spiny Lobster: Terms of Reference http://www.fao.org/fishery/docs/DOCUMENT/wecafc/WG_2012/OSPESCA-WECAFC-CRFM-CFMCWGSpinyLobster.pdf

the more formalised process of setting catch levels (WECAFC SAG, 2017). Thus, WECAFC is not yet fully involved in the process of setting catch levels or negotiating quota allocations between member states.

A1.10.3. Description of Sensitive Species and Habitats

Candidate VMEs have been identified and are recommended to be subject to review (WECAFC Draft recommendation 16/2016/4), including several seamount clusters in the north that have potential to complement the NAFO closed area network, and hydrothermal vent sites along the Mid-Atlantic Ridge axis, between 23 and 31 °N (Fig. A1.10.1; WECAFC, 2014). There is also a region of interest in the equatorial south Atlantic (between 0 and 5°S, in ABNJ waters adjacent to the Brazil EEZ) sector of the WECAFC convention area but limited data are available for this area and it is scheduled to be subject to further evaluation. Additionally, there is a small seamount chain at approximately 15°N, 50°W that rise to ~960 m, but this has not been put forward as a candidate for a bottom fisheries closure at this time.

Although several geomorphic features have been identified as areas at risk of bottom contacting activities, species lists for VME indicator taxa have yet to be agreed and the proposed areas are quite remote from the majority of the member states who, as discussed previously, have limited interest in the living resources therein. The candidate closures identified are largely quite deep, with only very small areas occurring in depths shallower than 1,000 m[156] and have high proportions of 'rough' grounds, where demersal trawling is more likely to encounter gear loss. Intermittent alfonsino (*Beryx splendens*)[157] catches have been reported from similar grounds in FAO area 21 (NW Atlantic) (WECAFC, 2014) but in general, interest in, and catches of, fish stocks in these areas of the WECAFC convention area seems to be quite low[158]. AIS data[159] for 2017 suggest that most vessels are engaged in fishing in ABNJ in the WECAFC convention area are likely to be pelagic longliners reporting under ICCAT requirements. These vessels are particularly active in the southern reaches of the WECAFC area, presumably targeting tropical tunas. In 2017, only a single vessel fitted for demersal gears (a German fisheries research vessel) was identified as being active in the high seas of the western Atlantic. There are known issues with AIS, in terms of the number of vessels carrying AIS instruments, how data are reported and the algorithmic detection of fishing activity, but these data would seem to suggest that current effort levels amongst demersal fisheries are very low. Particular hotspots of fishing activity within member states' waters occur along the Colombian, Venezuelan and USA margins, and around Puerto Rico. It is not clear what proportion of this activity is of relevance to deep-water demersal fishing, although it is unlikely to be substantial.

Despite WECAFC's large area of competence, the proportion where deep-water fisheries could potentially occur is very small (ca. 8.5 %) and very few of these areas occur within ABNJ (Fig A1.10.3). Consequently, even upon establishing itself as a RFMO, this limits WECAFC's capacity to enact measures relating to bottom fisheries in its area and means that most, if not all, area closures will need to be negotiated with member states (either as individuals or small groups). This situation is quite distinct from other organisations that have much more substantial areas of seafloor suitable for bottom fishing in their regulatory areas (e.g. NAFO or CCAMLR) and, barring a substantial change in the fishing activity by member states, suggests that there is limited need for WECAFC to invest heavily in a VME monitoring programme in the future.

Should WECAFC establish itself as a RFMO and seek to implement the candidate closures, a possible conflict exists with exploratory/ exploitation licences for seabed mining issued by the International Seabed Authority (ISA). The ISA has issued exploratory licences for polymetallic sulphides to Poland,

[156] Most bottom fishing in the adjacent NAFO regulatory area occurs in depths < 1200 m.
[157] Also known from the area are black cardinal fish (*Epigonus telescopus*), black scabbardfish (*Aphanopus carbo*) and wreckfish (*Polyprion americanus*) (FAO, 2016c)
[158] Although the lack of vessel data means this is quite uncertain.
[159] Source: Global Fishing Watch: http://globalfishingwatch.org/map/

France and Russia along the northern tropical Atlantic section of the Mid-Atlantic Ridge (~ 12 – 37°N), some of which overlap with the proposed closure[160]. This creates a potential for future conflict between fishing and mining sectors and could easily compromise the effectiveness of area closures by WECAFC, but at present this is not thought to be a major concern for WECAFC member states (FAO, 2016c).

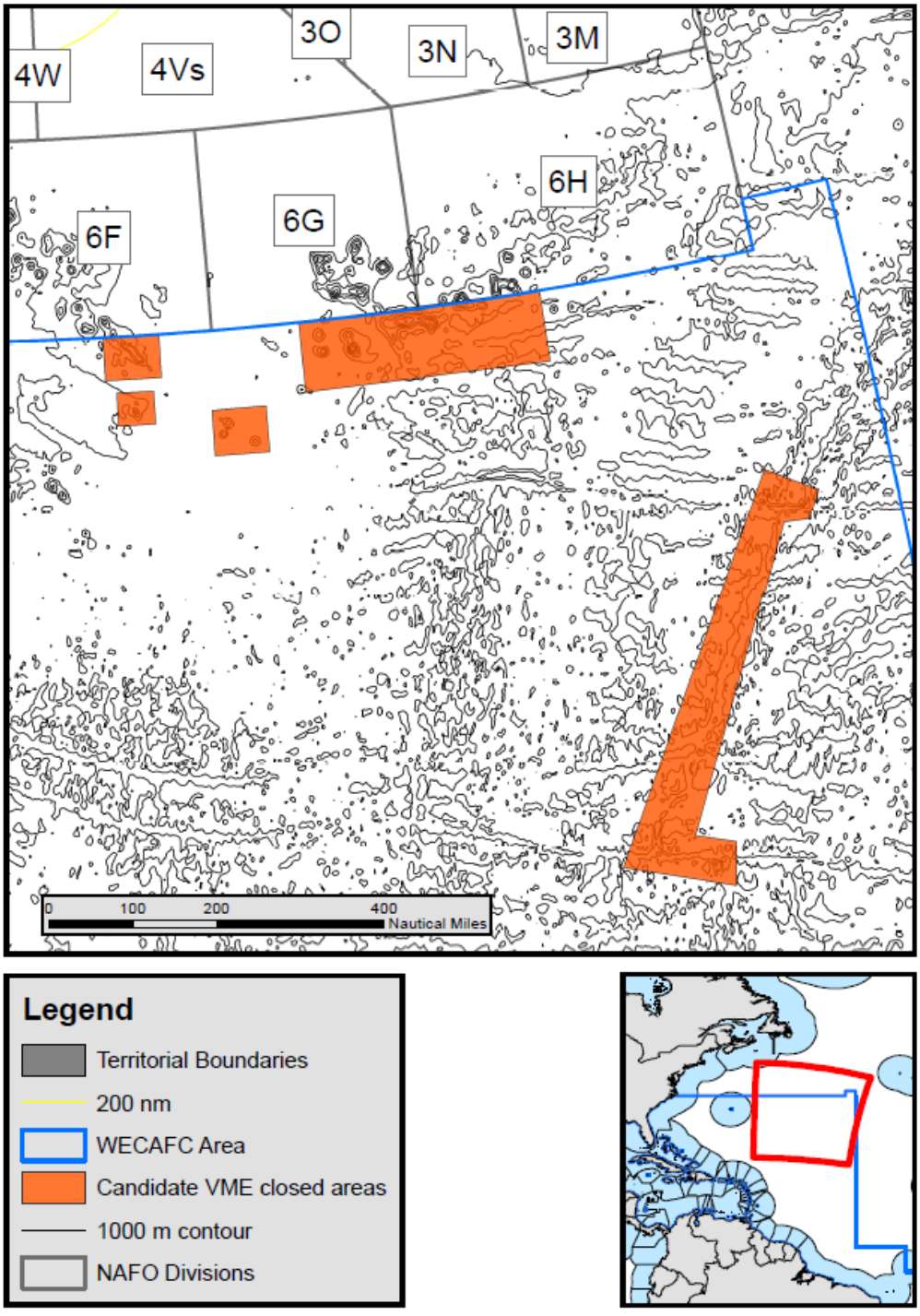

Figure A1.10.2 – Candidate bottom fishing closed areas encompassing NW Atlantic Seamounts and hydrothermal vents along the Mid-Atlantic Ridge. Contours derived from the GMRT v3.1 dataset. Red area on bottom-right panel indicates extent of top panel.

[160] https://www.isa.org.jm/contractors/exploration-areas

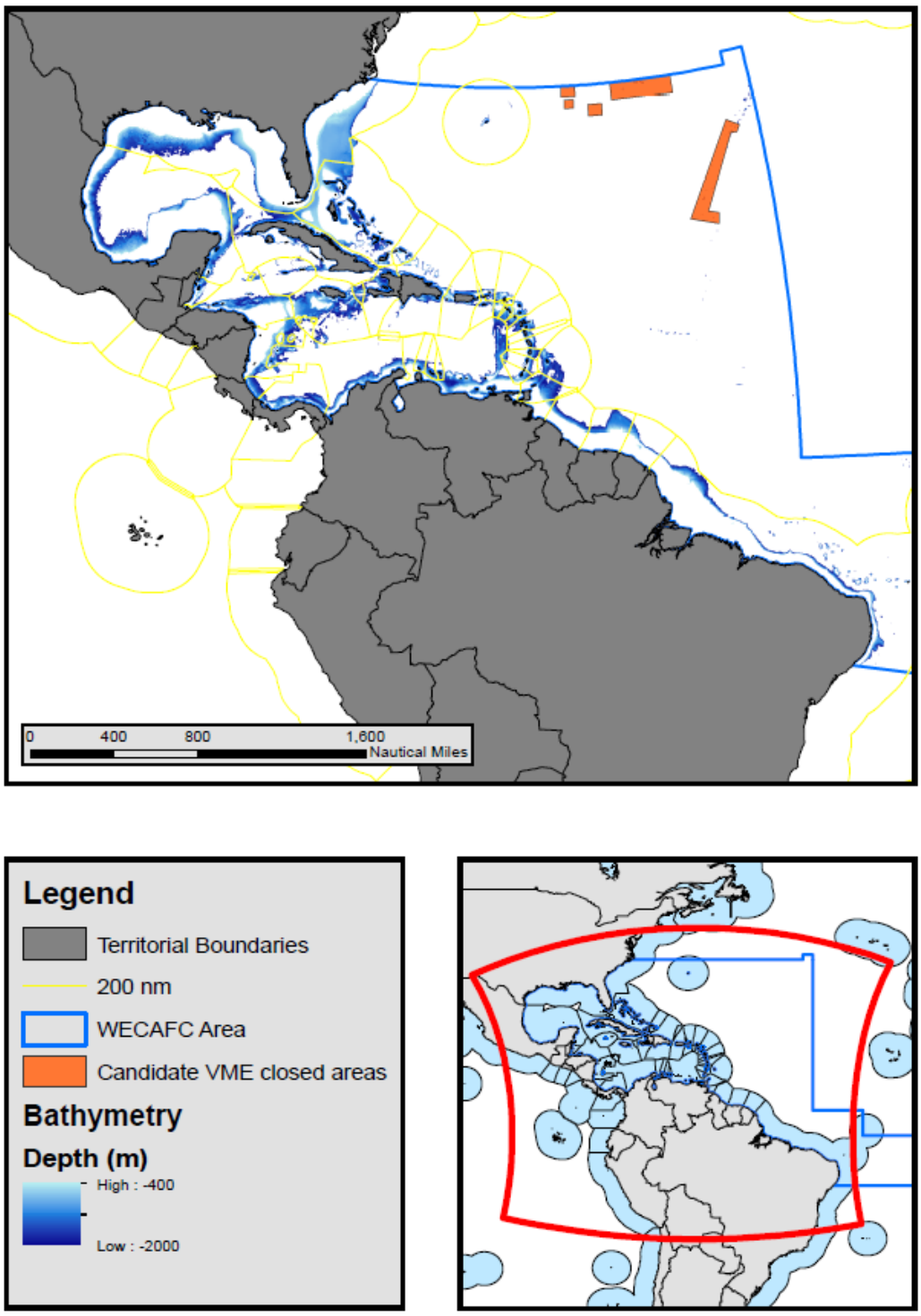

Figure A1.10.3 – Areas within the WECAFC convention area where seafloor presumed suitable for deep-water fisheries (400 – 2000 m). Red area on bottom-right panel indicates extent of top panel.

A1.10.4. Assessment of impacts upon sensitive species and habitats

WECAFC have committed to adopting FAO best practice guidelines in its recommendations, but whilst significant adverse impacts will be a consideration there is no evidence of any programme of fishery independent surveys, nor a programme of dedicated observers (FAO, 2016c). Consequently, if vessels fishing in the WECAFC area carry observers, this is either on a voluntary basis or as part of national requirements within a single State, including obligations to other RFMOs (e.g. 10 % observer coverage for ICCAT vessels). There is no standardised methodology for assessing significant adverse impacts and most of the VME candidate areas lack the requisite data to perform a baseline assessment.

The WG for the management of deep-sea fisheries (WECAFC, 2014) made a number of recommendations relating to the deep-sea fisheries and ecosystems in the WECAFC area:

- Short to medium term (< 5 years)
  - Generate awareness amongst member states and fishing groups about deep-sea fisheries and examples of best-practice;
  - Collect data on fishing in deep waters and in ABNJ, both by member state and foreign vessels.
  - Identify any pre-existing international requirements and legislation and attempt to implement them amongst member states;
- Longer term (< 10 years)
  - Support exploratory fishing (commercial and research) to investigate viability of deep-sea fisheries (in ABNJ and EEZs);
  - Develop policies and regulatory frameworks to allow member states to negotiate access agreements between states and in ABNJ;
  - Develop collaborative projects together with member states for research and data collection for existing deep-sea fisheries;
  - Encourage member states to identify VMEs within their own waters and support national programmes in VME impact management.

Upcoming areas of work for the deep-sea fisheries management WG:

a) Develop a research proposal for deep-sea fisheries and seek support (e.g. from the EAF-Nansen programme);
b) Develop a deep-sea fisheries regional capacity-building programme for member states.
c) Prepare and disseminate species guides for relevant species;
d) Desk-based review of historic fisheries in ABNJ in the WECAFC area;
e) Make official requests to distant fishing nations to request historic data on fishing in the area (e.g. VMS) and present these data to the Commission;
f) Collaborate with other organisations (e.g. NAFO) to improve data and knowledge sharing on deep-sea fisheries issues, vessels suspected of IUU and other matters.

The Commission has made some appropriate steps, in as much as it has shown willingness to take a wider ecosystem framework approach to deep-sea fisheries management. However, given the present state of the fisheries, and the Commission's lack of regulatory power, attempts to design and implement technical measures are justifiably absent at this stage.

A1.10.5. Mapping of sensitive species and habitats

There are no surveys of VMEs coordinated by WECAFC. The Caribbean Large Marine Ecosystem (CLME) programme, funded by the UN Development Programme between 2009 and 2014, with extension through to 2020 as CLME+, is involved in high level regional biodiversity assessments, but VMEs have apparently not been a consideration under this programme.

The current candidate closures total 209,393 km^2, approximately 0.10 % of the Convention area (or 0.21 % of WECAFC ABNJ). Although this is a very small proportion of the total area, it comprises a high proportion of the habitats presumed to host VMEs in ABNJ. However, the extent of VME is difficult to quantify as the type and extent of these ecosystems has not been studied and current estimations are made from topographic features, rather than known distributions. It is therefore unknown whether the proposed network of VME closures, several of which are contiguous with the NAFO closed area network, represents the diversity of seamount and hydrothermal vent habitats in the WECAFC area. It is possible that a larger network of individually smaller areas, spread further across the region would be more appropriate (e.g. to capture biogeographic variation in vent communities along the MAR), but there are no data on which to base proposals for new closures. The lack of previous surveys also means that there are no model data relating to habitat suitability or species distribution of the key VME indicator taxa for many of the areas.

Several of the vent ecosystems along the northern MAR have been subject to much more dedicated research (e.g. the Lost City and TAG vent fields), although much of this research relates to the mineralogy and geochemistry of the areas, rather than the resident biota. There may be sufficient regional evidence in most cases to assess the vulnerability of an individual vent field (e.g. Copley *et al.*, 1997), should fishing in these areas become a likely prospect. Additionally, for the hydrothermal vent ecosystems within the WECAFC area that are under exploration licences, there is likely to be a much more comprehensive and recent dataset on biological characteristics, but these data are held by the ISA and Contracting Parties. WECAFC may consider attempting to initiate a data sharing agreement with ISA especially if it wishes to explicitly consider hydrothermal vents in its closed area network, although ISA can, if it so wishes, declare such closures itself. It is not clear which of ISA or WECAFC would take precedence if one were to propose a closed area in an area targeted for exploitation by the other. Although mining and demersal fishing are both bottom-contact activities that pose risk to VMEs, they are quite different in terms of the scale and nature of the likely impacts. Trade-offs and conflicts between fishing and mining have yet to be explicitly addressed, since most proposed areas for seabed mining occur in waters much deeper than are usually of interest to demersal fishing (though this is not always the case in all areas, for instance phosphate nodules in the Namibian EEZ). There is also very little precedent for the regulation of fishing activities in the vicinity of hydrothermal vents, which is beyond the scope of this review.

A1.10.6 Impact mitigation and protection

The Convention area totals 205,075,545 km^2 and is considered to be stable. Only the southern margin is not bordered by a pre-existing organisation, which is under consideration to become part of the SEAFO Convention area. Sub-divisions to the area have not been agreed but a network of 24 areas has been proposed for FAO major statistical area 31 (Fig. A1.10.1).

WECAFC is not a RFMO so does not have a regulatory area and cannot introduce a mandatory set of conservation measures. VME closures have been proposed but these cannot presently be implemented and do not seem to be subject to any sustained fishing activity. There are currently no encounter rules but the organisation is committed to adopting best practice where feasible and so it is likely that, when appropriate, these will form part of the recommendations by the WG on the management of deep-sea fisheries.

Data on fishing catch and effort is being compiled by WG-FDS and may, in the future, form the basis for defining a fishing footprint within ABNJ.

A1.10.7. Monitoring of VME impacts

There is no current programme of plans for routine monitoring of VMEs and until the WG on deep-sea fisheries is able to determine what fishing activity happens in these areas, this is considered highly unlikely to change. The Commission has been made aware of options for implementing such programmes but, in the absence of fishing activity, there is limited need. Whilst the Commission remains a RFB, it will also be unable to declare area closures and so will be limited to relying upon cooperation from member states to agree voluntary technical measures to reduce the impact of any fishing activity by their vessels.

For this reason, the performance of WECAFC in its management of deep-sea fisheries is difficult to judge. The Commission is certainly forward thinking and has taken steps towards adopting best practice developed by FAO and other RFMOs, but has not had a direct opportunity to demonstrate how it, and its member states, would design and implement appropriate technical measures. Given the low area of VMEs within WECAFC ABNJ, a relatively low intensity management approach may be appropriate, but it is uncertain at this stage. There are large areas of potentially suitable deep-sea fishing grounds within the EEZs of individual member states and, although some states may have national programmes[161] of fish and/ or ecosystem surveys, this has yet to be incorporated into a RFB-wide framework. Certainly, the readily available information seems to suggest that reef and pelagic fish and invertebrates are the sole focus of targeted research effort[162]. Establishing VME closures in these areas requires a different suite of legislative instruments and varying levels of cooperation from member states, and would not require that WECAFC take on its own regulatory powers.

[161] The NOAA South-East Fisheries Science Center research apparently focusses upon pelagic and reef fishes https://www.sefsc.noaa.gov/research/

[162] NOAA 2012 Caribbean Fisheries Survey Workshop http://sero.nmfs.noaa.gov/sustainable_fisheries/caribbean/fish_indep_wkshp/index.html

DEFINITION OF TERMS:

Areas Beyond National Jurisdiction (ABNJ)	Areas of ocean not subject to control by a single state. Generally managed under UN Convention on the Law of the Sea.
Basic Texts	Constitution or other set of basic texts agreed upon at the creation of the organisation that sets out its responsibilities, area of competence, structure etc.
Bottom fishing	Use FAO definition, unless the organisation specifies its own definition.
Bycatch species	Any species which is not landed. Includes over-quota fish species, sessile organisms (e.g. corals) as well as marine apex predators (e.g. sharks or seabirds).
Contracting Party	Signatories to Regional Conventions, e.g. RFMOs
Convention Area	Geographical area where a conservation/management Convention applies, as described in the basic texts of such Convention.
Catch Area (CA)	Organisation's area of competence, in which it takes responsibility for management of stocks not confined to the territory of a single coastal state. Also referred to as the Convention Area.
Coastal State	State whose maritime boundaries border the organisation's RA
Cooperating Party (CP)	State that is not a coastal state or otherwise a full member of the organisation, but which still fishes within the CA. Usually not permitted to vote at Commission meetings. May also be termed Cooperating Non-Contracting Party (CNCP).
Commission	General assembly of member states and the organisation staff. Responsible for agreeing organisation operations. Usually led by a small number of representatives, elected from amongst the member states to serve for a defined term.
Cooperating Non-Contracting Party (CNCP)	See Cooperating Party.
Deep-water fisheries (DWF)	Any fishing at or below 400 m depth.
Demersal fishing	Any fishing methods during which gear is expected to contact the seafloor for some or all of a typical deployment.
Exclusive Economic Zone (EEZ)	Waters, and rights to any resources therein, which belong exclusively to a single State.
Habitat Suitability Model (HSM)	A spatially explicit model of habitat suitability for a given group of organisms that uses environmental data and occurrence records to infer wider patterns in distribution. See also species distribution model.
IUU	Illegal, Unregulated and Unreported Fishing

Management Strategy Evaluation (MSE)	Formalised process of assessing the effectiveness of different management strategies upon fish stocks or ecosystems
Marine Protected Area (MPA)	Any form of spatial management that incorporates some level of biodiversity protection.
Member	Used in the same way as Contracting Party to an RFMO or RFB
Member State	State (or group of states) that have fully ratified and approved the basic texts and fish within the organisation catch area. Also called Contracting Party.
Observing Party	States or other groups (e.g. NGOs), which take an interest in the activities of the organisation but whom do not fish within its CA or have voting rights at the Commission.
Organisation	Regional Fisheries Management Organisation or Body.
Pelagic fishing	Any fishing methods during which gear would not be expected to contact the seafloor, under normal operations.
Regulatory Area (RA)	Area of jurisdiction delimited by the organisation's basic texts. Often a subset of the catch area, beyond national jurisdiction.
Scientific Committee (SC)	Any part of the organisation structure which focusses specifically upon the preparation and delivery of scientific advice.
Significant Adverse Impacts (SAI)	Use FAO definition[163], unless the organisation specifies its own definition.
Species Distribution Model (SDM)	Subset of HSMs that usually refer to individual species or genera.
Vulnerable Marine Ecosystem (VME)	Use FAO definition, unless the organisation specifies its own definition.
VME Indicator Species	Any taxon that is considered to be indicative of the presence of a VME
Working Group (WG)	Temporary or permanent part of the organisation that usually focusses upon providing scientific and management recommendations regarding a clearly defined aspect of the organisation's activities.

[163] FAO definitions for deep-sea ABNJ fisheries: http://www.fao.org/fishery/topic/166308/en

LIST OF ACRONYMS

Acronym	Definition
ATLAFCO	Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic Ocean
CAN	Capacity – Action – Need (Scoring method in comparative analysis)
CCLME	Canary Current Large Marine Ecosystem
CEMs	NAFO Conservation and Enforcement Measures
COREP	Regional Fisheries Commission for the Gulf of Guinea
CWC	Cold Water Coral
DCF	EU Data Collection Framework
DWFN	Distant Water Fishing Nation
FC	Fisheries Commission
FCWC	Fishery Committee for the West Central Gulf of Guinea
FIRMS	Fisheries Information Monitoring System
FRA	Fishery Restricted Area
FTE	Full-time Equivalent
GPV	Gross Production Values
GSA	Geographical Sub-Area
NRA	NAFO Regulatory Area
PFE	Participating Fishing Entity
RFB	Regional Fishery Body
RFMO	Regional Fisheries Management Organisation
SAI	Significant Adverse Impact
SFPA	Sustainable Fisheries Partnership Agreement
SLC	FAO Sub-Regional Office for the Caribbean (also the WECAFC Secretariat)
SSC	CECAF Scientific Sub-committee
SRFC	Sub-regional Fisheries Commission
STACFAD	NAFO Finance and Administration committee
STACTIC	NAFO Committee on International Control
STATLANT	NAFO catch statistics database
WG-EAFFM	NAFO WG on Ecosystem Approach Framework to Fisheries Management
WG-ESA	NAFO WG on Ecosystem Science Assessments
WGVME	GFCM WG on Vulnerable Marine Ecosystems

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EA-02-19-180-EN-N

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doi: 10.2826/35050 [PDF]

doi:10.2826/08577 [HTML]